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December 1, 1988 151819

CONFIDENTIAL FOR SETTLEMENT PURPOSES ONLY

By Messenger

Charles McKinley, Esq.
Assistant Regional Counsel
U.S. Environmental Protection Agency
230 South Dearborn Street (5CS-TUB)
Chicago, Illinois 60604

Re: Proposed Enviro-Chem Consent Decree

Dear Mr. McKinley:

As a follow up to the meeting which we had on November 12, 1988, I am enclosing herewith a revised draft of the Enviro-Chem Consent Decree.

The principal changes are as follows. The latest draft adds background information (pp. 4-5), the inter-relationship with the amendment to the ROD (p. 6), eliminates provisions on conveyance of the facility since Bankert will not be a party (pp. 12-13) and substitutes the Northside decree versions of force majeure (pp. 21-23) and stipulated penalties (pp. 27-34) with adjustments necessary to conform to the balance of the decree. Additionally, all references to the scope of work and work plan have been deleted and the neutral term "Appendix A" has been substituted.

The "X" version shows the changes from the preceding draft and the "Y" version is after giving affect to those changes.

ERM-North Central, Inc.
Environmental Resources Management

102 Wilmot Road • Suite 300 • Deerfield, Illinois 60015 ☎ (312) 940-7200

November 3, 1988

Elizabeth Maxwell
Office of General Counsel
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

RE: ECC Remedial Action Work Plan

Dear Ms. Maxwell:

As instructed by the ECC Steering Committee, enclosed please find one (1) copy of the Confidential Preliminary Draft for Settlement Purposes Only of the Remedial Action Work Plan for the Environmental Conservation and Chemical Corporation (ECC) site at Zionsville, Indiana

Very truly yours,

ERM-NORTH CENTRAL, INC.

Roy Ball /EFM

Roy O. Ball, Ph.D.,P.E.
Principal

jls

Enclosures

cc: M. Grummer
K. Vendl ✓
A. Sloan
J. Buck
D. Smith
J. Amber
N. Bernstein
T. Harker

CONFIDENTIAL PRELIMINARY DRAFT
FOR SETTLEMENT PURPOSES ONLY

REMEDIAL ACTION WORK PLAN
DETAILED ANALYSIS

ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION (ECC) SITE
ZIONSVILLE, INDIANA

NOVEMBER, 1988

PREPARED FOR:

ECC SETTLERS STEERING COMMITTEE

PREPARED BY:

ENVIRONMENTAL RESOURCES MANAGEMENT-NORTH CENTRAL, INC.
102 WILMOT ROAD, SUITE 300
DEERFIELD, ILLINOIS 60015

PROJECT NO. 8076

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

REMEDIAL ACTION WORK PLAN
DETAILED ANALYSIS

ENVIRONMENTAL CONSERVATION AND
CHEMICAL CORPORATION (ECC) SITE
ZIONSVILLE, INDIANA

1.0 INTRODUCTION

This is a Remedial Action Work Plan (RAWP) for the ECC Site. The RAWP addresses all environmental concerns regarding the site, namely:

- o direct contact with soils containing volatile organics (VOCs), semivolatile organics, and heavy metals;
- o contamination of ground water by rain water percolating through soils containing VOCs, semivolatile organics, and heavy metals;
- o contamination of surface waters by overland migration of water in contact with soil containing VOCs, semivolatile organics, and heavy metals;
- o ingestion of ground water containing VOCs, semivolatile organics, and heavy metals; and

- contamination of surface waters by discharge of ground water containing VOCs, semivolatile organics and heavy metals.

as compared to what (delete)

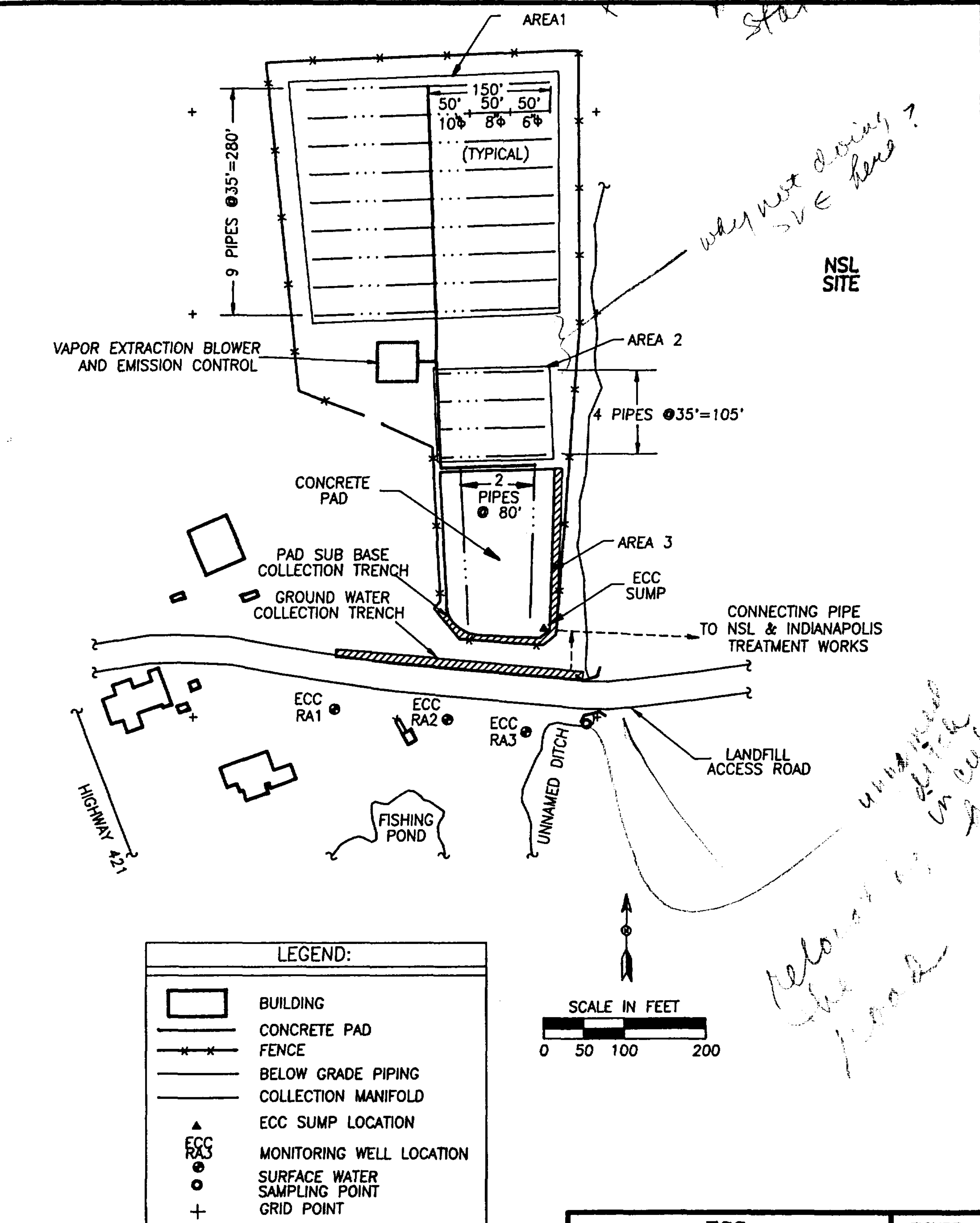
Additionally, the RAWP most closely complies with the Superfund Amendments and Reauthorization Act (SARA) of 1986 by removing VOCs from the soils and destroying them.

The RAWP includes the components listed below (Figure 1):

- soil vapor extraction, concentration and destruction;
- soil cover;
- diversion of surface water runoff upgradient of concrete pad and collection of water from beneath the concrete pad;
- shallow saturated zone ground water interception and collection;
- access restrictions; and
- ground water and surface water monitoring.

The following sections present for each component: (1) description and technical basis, (2) objectives, and (3) performance standards which would be utilized to evaluate their effectiveness. A schedule for implementation of the work plan is also presented.

Although the detailed design of the Northside Sanitary Landfill (NSL) remedial action plan has not been finalized, the plan



NOTE: EXISTING SITE STRUCTURES ARE NOT SHOWN FOR THE SAKE OF CLARITY.

ECC REMEDIAL ACTION PLAN SCHEMATIC	FIGURE 1
ERM ERM–North Central, Inc.	10/27/88
	cs

How do you know this hasn't been in [illegible]?

presented herein is compatible with the proposed remedy for the NSL site. If necessary, modifications to the design will be done to merge both remedies appropriately.

2.0 SOIL VAPOR EXTRACTION, CONCENTRATION AND DESTRUCTION

Objectives

- o remove and destroy existing VOCs from the soils (as provided herein) and thereby:

    1) prevent contact with contaminated soils, if any;

    2) prevent migration of contaminants, if any, from the soils to the ground water; and

    3) prevent migration of contaminants, if any, from the ground water to the surface water.

Description

Soil vapor extraction would remove existing VOCs from the soils by enhancing and accelerating volatilization.

To accomplish this, pipelines would be installed in trenches dug in the soils. The vacuum pressure developed by the extraction system will cause the VOCs in the soils to migrate to the pipelines and into the vapor treatment system. The vacuum is provided by a blower. The vapor treatment system would consist of preconcentration of the VOCs by adsorption on activated carbon and destruction of the VOCs by incineration.

The effectiveness of vapor extraction for VOC removal from the soils was demonstrated during a pilot test run by Terra Vac in June 1988 (Appendix A). The test showed an initial high VOC extraction rate of about 1.9 lb/d per foot of trench that decreased with time to a steady-state rate of about 0.25 lb/d per foot of trench.

Prior to startup of construction of the vapor extraction system, the following activities would be conducted:

- level out the site's surface;
- relocate movable objects;
- provide three-phase, 440 volt electrical service;
- construct a 20' x 20' concrete pad for the blower emission control system; and
- mobilize a trailer and minor utilities.

The trenches would have the same cross-section as in the pilot test, i.e., a minimum of 1 foot in width and a total of 9 feet in depth. Under the concrete pad, the depth of the vapor extraction trench would be reduced to 5 feet, because the concentrations of compounds detected in the soils are below the acceptable remaining soil concentrations calculated below (see page 7).

As shown in Figure 1, the site has been divided into three separate areas based on the site dimensions. The layout of the vacuum extraction system is also presented in Figure 1. The Area 1 and Area 2 trenches would have a 35-foot separation, based on a radius of influence of 15 to 20 feet found during the pilot test

(Appendix A). The trench separation beneath the concrete pad would be 80 feet, assuming that the radius of influence would double in the subbase of the concrete pad, which has a higher permeability than the shallow till. The length of the trenches would be 150 feet, 100 feet and 200 feet in Areas 1, 2, and 3, respectively, based on the dimensions of each zone.

Trenches would be dug by a conventional backhoe using a narrow width bucket. The dirt would be placed directly in a lined, light dump truck and/or stockpiled for removal by a front-end loader. The excavated dirt would be placed in windrows on the existing concrete pad for subsequent vapor extraction (Area 3 on Figure 1) installing an extraction pipe at the bottom of the windrows and connecting it to the vapor extraction system. The trenches under the concrete pad would be laid on the pad's subbase and dug in a similar way. The concrete debris would be placed on top of the concrete pad and leveled out. A maximum of 1800 cubic yards is expected to be excavated during trench construction.

A 4-inch slotted PVC pipe would be placed at the 8-foot level within the trenches to drain off any ground water that may accumulate in the trenches. This pipe would be connected to a 4-inch PVC riser which would be manifolded at the surface and connected to a positive displacement pump for water removal and discharge to the ground water interception system.

The vapor extraction pipe would be located at the 6-foot level and would consist of 50 feet each of 6-, 8- and 10-inch slotted PVC pipe. The pipe size was selected to have a maximum velocity of 40 feet per second (fps) before transition to the next section. The pipe would be connected via a 10-inch riser to the surface for connection to the above ground vacuum manifold.

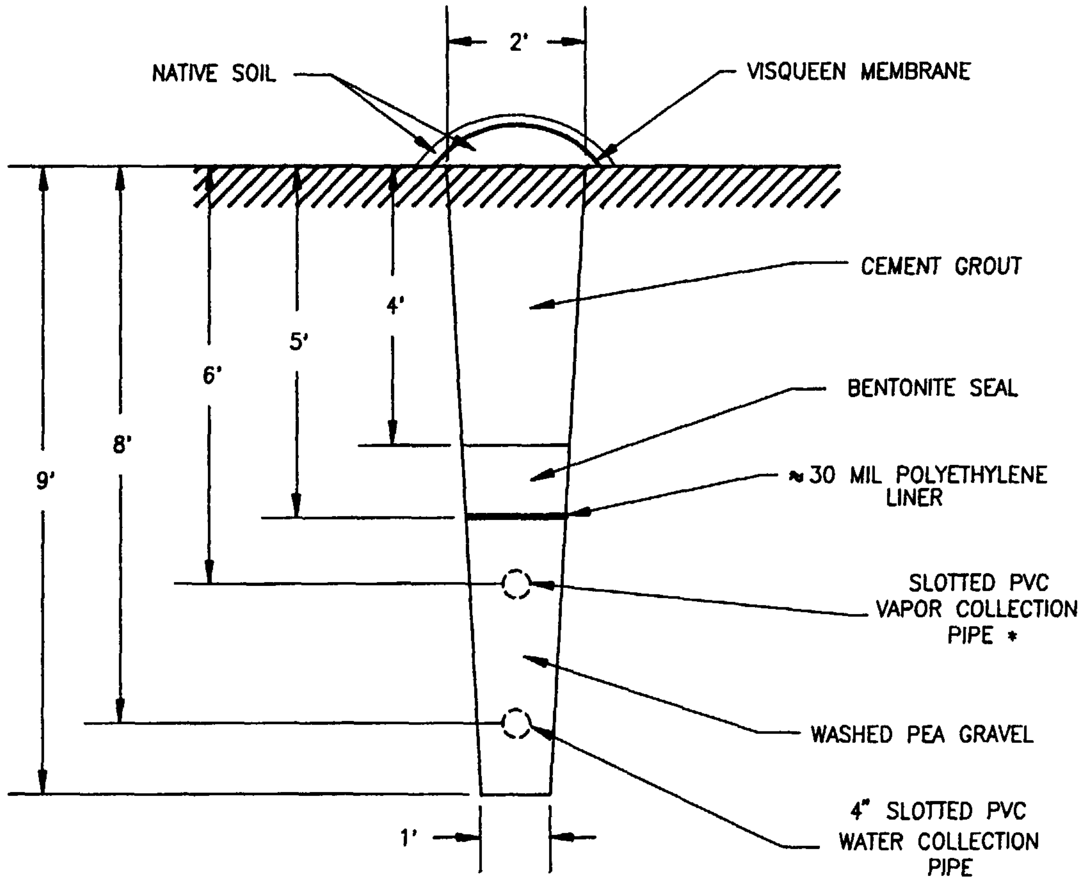
The trenches would be filled to the 5-foot level with pea gravel, which would be covered with a 30 mil or greater thickness polyethylene liner. A one-foot thick bentonite seal would be constructed on top of the liner using hydrated bentonite pellets. The trench would be filled to grade (approximately 4 feet) with a cement grout mixture and slightly mounded with native soil and visqueen membranes to prevent infiltration of surface water and vacuum breakthrough to the surface (Figure 2).

not [illegible] see [illegible] Table F-2A

The vapor extraction trenches underneath the concrete pad would be modified as follows: (1) the water and vapor extraction pipes would be located at the 4-foot and 3-foot level, respectively; (2) the trench would be filled to the 2-foot level with pea gravel, covered with a 30-mil liner and filled to the one-foot level with a bentonite seal; and (3) the trench would be filled to grade and slightly mounded with a cement grout mixture.

The trench vapors would be collected in an above ground manifold. The manifold would be insulated and would change in size from 1′ x 1.25′ at the start of the manifold system to a nominal 3′ x 3′ at the connection to the blower plenum, to accommodate the increased flow of vapors. The blower plenum would be designed to receive 25,000 SCFM at a nominal 4′ x 4′ size. The surface manifold would be sloped to allow the removal of any condensation which may form. The water collected in the condensation trap would be combined with the water collected in the trenches and conveyed to the Indianapolis sewage treatment system (see Section 5).

The vapor extraction blower motor and control system would be capable of removing a nominal 25,000 SCFM against a resistance of 3" Hg (equivalent to about 400 HP). After initial extraction development during the pilot test, a steady-state soil resistance of 2-1/2" Hg was measured. Therefore, the piping and manifold system would be designed for a maximum resistance of 1/2" Hg (a



* SIZE VARIABLE, DEPENDING ON LOCATION (SEE FIGURE 6)

NOTE: NOT TO SCALE

ECC REMEDIAL ACTION PLAN
VAPOR EXTRACTION
TRENCH SCHEMATIC

FIGURE 2

ERM ERM–North Central, Inc.

10/27/88

CS

higher vacuum). The controls would consist of motor control and starter with automatic shut-off in the event of: (1) excessive condensation in the vacuum system; (2) high or low suction pressure levels; and (3) failure of the VOC adsorption/concentration system.

The exhaust VOC adsorption/concentration system would collect the VOCs extracted from the soil and would consist of three 12-foot diameter unlined carbon steel vessels, each holding approximately 13,600 pounds of granular activated carbon. This is based on: (1) a flow rate of 25,000 SCFM; (2) concentrations of trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA) in the vapors of 34 ppmv and 16 ppmv, respectively, as detected during the pilot test; (3) a carbon capacity for these two compounds of about 25% by weight; and (4) an assumed total mass of VOCs of about 5,500 pounds. This carbon system would be able to handle the entire mass of VOCs extracted from the soils during the remediation. Based on the soil samples collected during the RI, it was estimated that about 4,700 lb of VOCs were present in the soils (Table 1). Therefore, the amount of carbon in the system is about 20% more than the theoretical required amount.

After vapor extraction is completed, the spent carbon containing the extracted VOCs would be transported to a licensed off-site RCRA facility. At the facility, the VOCs would be stripped and destroyed and the carbon regenerated by high temperature incineration. RCRA [illegible]

Samples of the extracted vapor and the exhaust vapor would be collected daily during the first week of operation, weekly for the following 4 weeks, and monthly thereafter. Samples would be analyzed for VOCs. Also, flow rate would be monitored and recorded, to provide enough data to calculate the mass of VOCs removed from the soils.

TABLE 1

ECC REMEDIAL ACTION PLAN
ESTIMATE OF VOC MASS IN THE SOILS *

Location	Sampling depth ft	Assumed contamination depth, ft	Total VOCs concentration ug/kg	Mass of VOCs lb
TP-1	1 - 1.5	2	102	0.014
TP-2	1 - 1.5	2	28	0.004
TP-3	1 - 1.5	2	107,700	14.827
TP-4	1 - 2	2.5	97,330	16.749
TP-4	2.5 - 3.5	4	16	0.004
TP-5	1 - 2	2	22,587	3.109
TP-5	2 - 3	1.5	291	0.030
TP-6	1 - 2	2	10,505,000	1,446.173
TP-6	2 - 3	1.5	22,450	2.318
TP-6	4 - 5	1.5	16	0.002
TP-7	1 - 2.5	2.5	231,000	39.751
TP-7	2.5 - 4	2	279,200	38.436
TP-8	1 - 2.5	2.5	67	0.012
TP-8	2.5 - 4	2	315,600	43.447
TP-9	1 - 3	3	14,604,000	3,015.694
TP-9	3 - 5	2.5	130	0.022
TP-10	1 - 3	3	108	0.022
TP-10	3 - 5	2.5	92	0.016
TP-11	1 - 3	3	130	0.027
TP-11	3 - 5	2.5	67	0.012
TP-12	1 - 3	3	34,690	7.163
TP-12	3 - 5	2.5	3,609	0.621
SB-01	2.5 - 4	3	3,303	0.682
SB-02	2.5 - 4	3	12,900	2.664
SB-03	2.5 - 4	3	70,070	14.469
SB-04	2 - 3.5	2.5	175	0.030
SB-06	2 - 3.5	2.5	220,900	38.013
SB-08	2.5 - 4	3	3,012	0.622
SB-09	2.5 - 4	3	60,390	12.470
SB0104	5.5 - 7	2	27	0.004
SB0204	5.5 - 7	2	34	0.005
SB0403	5 - 6.5	2	51	0.007
SB0805	7 - 8.5	2	188	0.026
SB0904	5.7 - 7	2	8,069	1.111
			TOTAL VOCs, lb	4,698.555

* The area contaminated is assumed to be a 25'x25' square around each sampling location. TP = test pit; SB = soil boring. Soil concentrations from ECC RI.

A1 ?

The time required for soil treatment has been estimated by calculating acceptable remaining concentrations using the procedures detailed in the Endangerment Assessment Section and Appendix E of the RI. Table 2 presents the maximum and average concentrations of indicator VOCs (TCE, tetrachloroethylene (PCE), chloroform and methylene chloride) as detected in the soil samples during the RI investigation. The values presented in Table 2 are very conservative considering that access restrictions would be maintained and a cover placed on the site.

At the acceptable concentrations presented in Table 2, leaching of the compounds, if any, to the ground water and subsequent transport to the surface water would result in a risk at least two orders of magnitude lower than the predicted risk shown in Table 6-13 of the RI.

As shown in Table 2, TCE and PCE are the most significant indicators. Therefore, only the time required to remove these two compounds was calculated. During the pilot tests (Appendix A), the steady state removal rates of trichloroethene and tetrachloroethene were 0.1 lb/day per foot of trench and 0.02 lb/day per foot of trench, respectively. Both compounds were detected at the highest concentration in trench TP-6, at a depth of 1-2 ft.

In order to estimate the duration of treatment, it was conservatively assumed that an area of 625 ft^2 around sampling locations has the same concentration of compounds, and therefore the mass of TCE at TP-6 is 660 lbs, and the mass of PCE at TP-6 is 90 lbs. For a 99.92% removal of TCE (Table 2), the current maximum mass would have to be reduced to 0.6 lb, which at a rate of 0.1 lb/day per foot of trench would take about 265 days (using a trench length of 25 ft crossing the area). Similarly, for PCE the required time would be about 180 days. If lower

TABLE 2

ECC REMEDIAL ACTION PLAN
CALCULATION OF ACCEPTABLE REMAINING SOIL CONCENTRATIONS
BASED ON DATA AND METHODOLOGY IN THE ECC RI

Parameter	Compound (1) TCE	PCE	CHLO	MECH
Maximum concentration, ug/kg	4,800,000	650,000	2,900	310,000
Location of maximum concentration	TP6(1-2')	TP6(1-2')	SB02(2.5-4')	TP3(1-3')
Excess risk identified in Tables 2 and 4 of Appendix E of the ECC RI, maximum concentration (2)	1.2 E-3	3.0 E-4	2.6 E-6	2.5 E-6
Average concentration, ug/kg	354,300	52,900	370	32,800
Excess risk identified in Tables 2 and 4 of Appendix E of the ECC RI, average concentration (2)	8.8 E-5	2.4 E-5	3.4 E-7	2.7 E-7
Concentration for acceptable risk, calculated, (2) ug/kg	4,000	2,100	1,100	124,000
Required removal, %				
Maximum concentration	99.92	99.68	62	60
Average concentration	99.0	96.0	--	--

(1) TCE = Trichloroethene
PCE = Tetrachloroethene
CHLO = Chloroform
MECH = Methylene Chloride

(2) Based on ingestion of 1 gram of soil per day by a 70 Kg person over a period of 70 years (an intake rate of 0.013 g/Kg/d).

A1?

concentrations are present, the treatment duration would be reduced accordingly.

Performance Standards

The vapor extraction system would have completed its task when:

- o the exhaust vapors contain less than 1 ppmv of VOCs; and
- o the average concentrations of TCE, PCE, chloroform and methylene chloride in the soils, as determined by vapor measurements and calculations, are reduced to the following levels: TCE - 4000 ug/kg; PCE-2100 ug/kg; chloroform - 1100 ug/kg; and methylene chloride - 124,000 ug/kg.

have #s above this below beneath SVE system

use soil samples in addition to vapor

3.0 SOIL COVER

Objectives

- o prevent human contact with remaining contaminated soil, ~~if any~~;
- o prevent contamination, ~~if any~~, of surface runoff;
- o reduce the infiltration of water through the soils; if any
- o promote evapotranspiration; if any

- o promote drainage of rain water away from the site; and

- o mitigate erosion.

Description

The soil cover would consist of a 0.5 foot layer of the highly impermeable native soil, 60 mil HDPE plastic membrane and a 2-foot layer of top soil to support vegetation (Figure 3).

Prior to placing the soil cover, the site would be graded to fill existing depressions and eliminate sharp grade changes and would be sloped at about 1% to promote drainage. Vegetation to be established would be characterized by fibrous, shallow, laterally growing roots, such as grass.

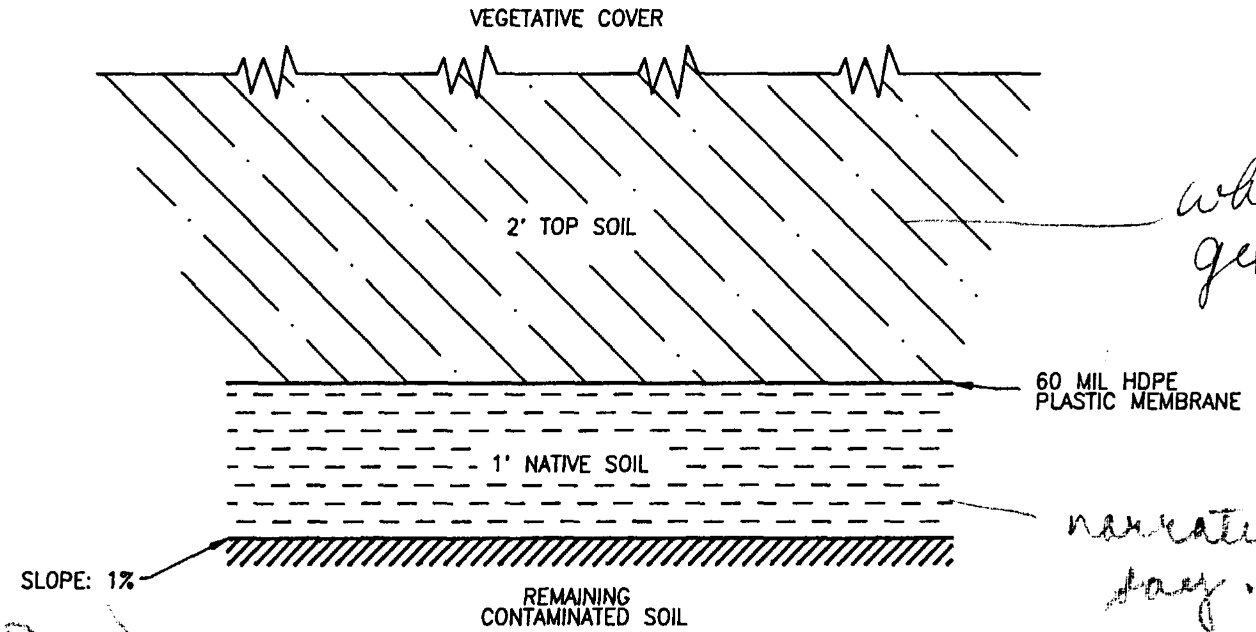
The cover would be installed over all the site, after soil remediation is completed. Approximately 5300 cubic yards (cy) of native soils, 21,000 cy of top soil and about 23,000 square yards of plastic membrane would be required.

Performance Standards

- o the inflow of ground water to the various interception trenches would be reduced as a result of decreased infiltration;

- o erosion would be minimal; and

- o a vegetative cover would be present over the site.



where to get this

narrative say .5 ft

Maybe

State 2-4% slope

ECC REMEDIAL ACTION PLAN CROSS SECTION OF SOIL COVER	FIGURE 3
ERM ERM–North Central, Inc.	10/27/88 cs

4.0 DIVERSION OF SURFACE WATER RUNOFF UPGRADIENT OF CONCRETE PAD AND COLLECTION OF WATER FROM BENEATH THE CONCRETE PAD

Objectives

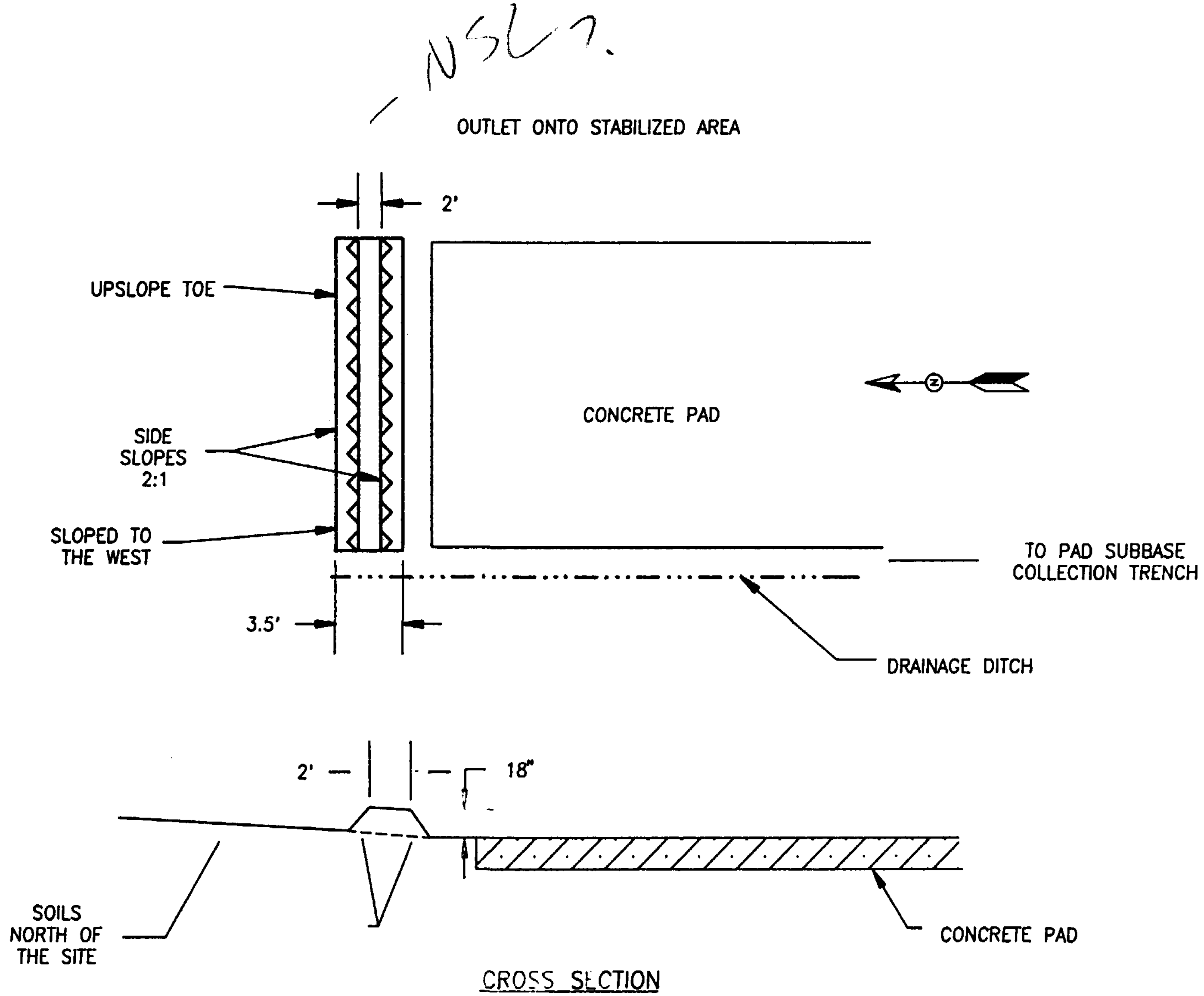
- prevent the infiltration of surface runoff beneath the concrete pad; through ?
- eliminate the concrete pad subbase as a migration route for contaminants, if any;
- prevent contamination, if any, of the saturated surface till beyond the concrete pad; and
- collect the water, if any, that may become contaminated through flow beneath the concrete pad. – how will this happen – ? is beneath pad 10' ...

Description

purpose of berm, what about causing problems w/cap on N side

Surface water runoff from the northern part of the site largely flows south, where an existing berm along the north edge of the concrete pad redirects runoff to a drainage ditch west of the site. This berm would be repaired and/or reinforced to ensure that runoff cannot infiltrate beneath the concrete pad (Figure 4). This would essentially eliminate the generation of contaminated runoff into the USEPA - installed sump located at the south end of the pad. ? doesn't make sense

An estimated 0.1 gpm would be diverted by this system, assuming a drainage area equal to 1/2 of the northeastern section of the site would drain towards the concrete pad (approximately 20,800 ft^2), a runoff coefficient of 0.1 and a precipitation rate of 40 in/year.



NOTE: NOT TO SCALE

ECC REMEDIAL ACTION PLAN SURFACE WATER RUNOFF DIVERSION BERM	FIGURE 4
ERM–North Central, Inc.	10/27/88 cs

Prior to placement of the soil cover, the diverted surface runoff would be conveyed to the Indianapolis Wastewater Treatment Plant. Subsequent to cover placement, surface water runoff would be directed, as storm water runoff, to Finley Creek.

monitor this?

In addition to the diversion of surface runoff, a lined collection trench approximately 4 feet deep by 1 foot in width would be installed along the south and southeast portions of the concrete pad (Figure 5). The trench would be sloped to the southeastern corner of the pad. The water collected from this trench will be analyzed periodically, as presented in Section 5.0. The water would then be mixed with the rest of the water from the site and conveyed to the Indianapolis sewerage system for final treatment.

purpose of this trench?

Once the surface water diversion system is installed, the amount of water flowing into this trench would be negligible. Initially, a flow of 0.6 gpm is estimated based on a precipitation of 40 in/yr, a 5% infiltration of rain water through cracks and around the edges of the pad , and a surface area of 27,300 ft^2.

Aug 24 memo says 0.06gpm

Performance Standards

- o minimal amounts of water would go beneath the concrete pad; and

- o contaminated water, if any, infiltrating beneath the pad would be collected in the trench.

How to measure?

directions?

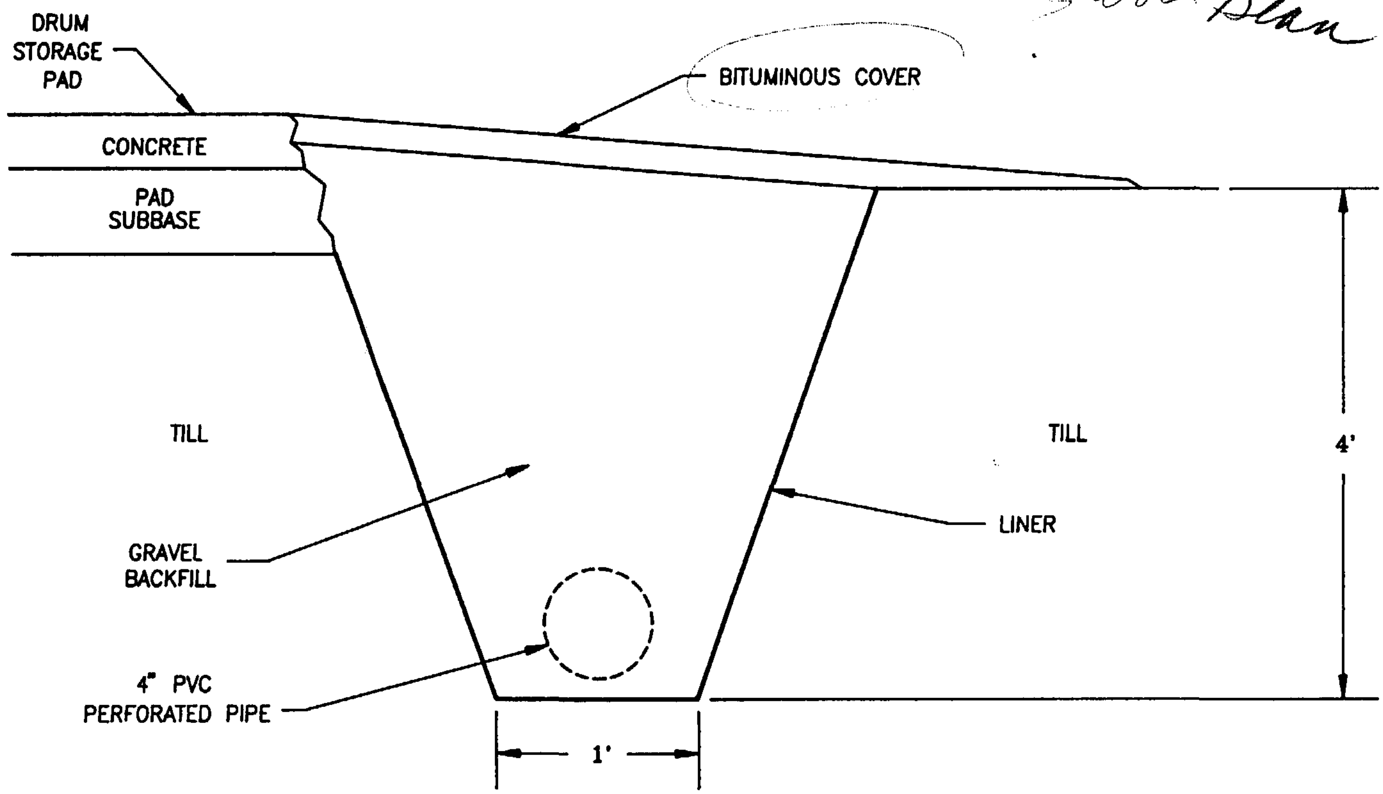
N

road

?

asphalt – how thick ?

→ work plan



NOTE: NOT TO SCALE

ECC REMEDIAL ACTION PLAN CONCRETE PAD DRAIN	FIGURE 5
ERM–North Central, Inc.	10/27/88 cs

5.0 SHALLOW SATURATED ZONE GROUND WATER INTERCEPTION AND COLLECTION

Objectives

- collect contaminated ground water, if any, from the saturated till escaping removal by soil aeration.

Description

The ground water interception system would consist of a french drain extending east-west south of the ECC site along the north side of the NSL access road (Figure 1). The road would remain open at all times during construction and later operation of the french drain system. The drain would be approximately 330 feet in length, 4 feet in width and would be variable in depth depending upon till thickness.

A schematic of the trench components is shown in Figure 6. A cross-section of the trench is presented in Figure 7.

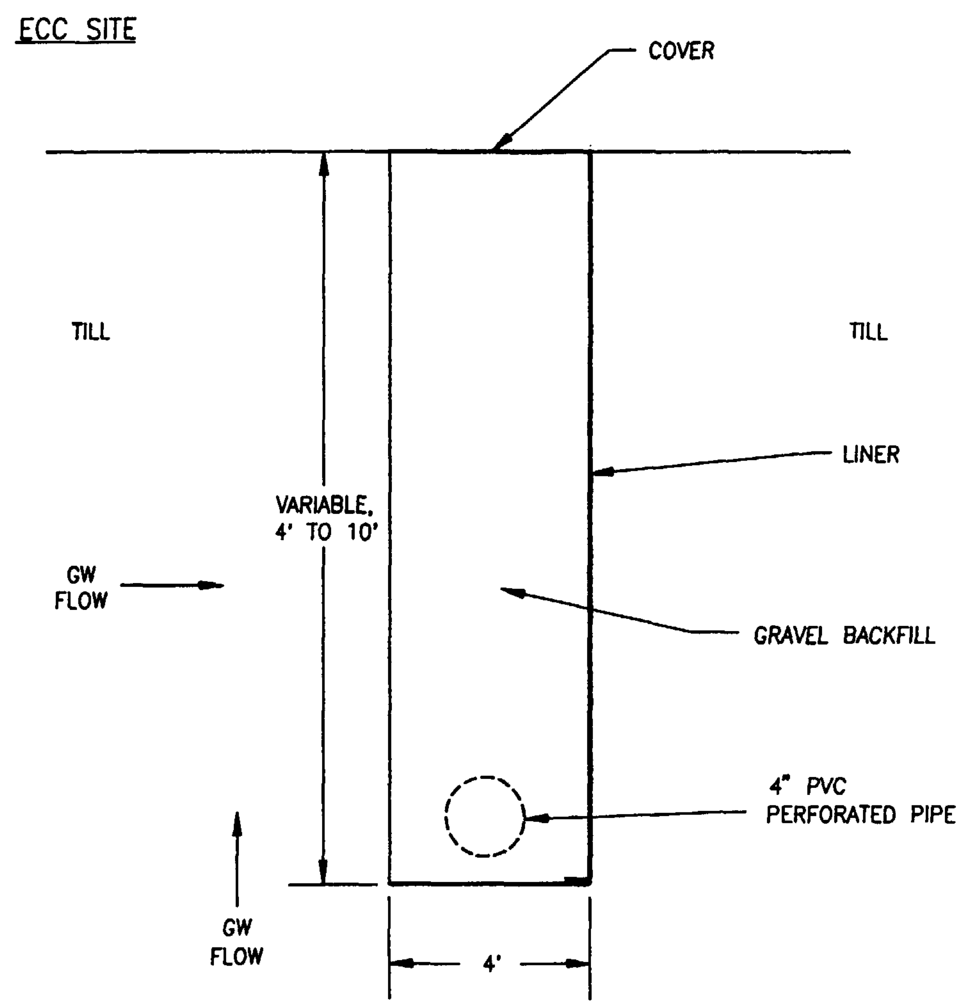
A 4-in PVC perforated pipe would be installed at the bottom of the trench. Gravel would be used for backfilling the trench. A plastic liner would be installed in the south and lower boundaries of the trench to prevent collection of uncontaminated downgradient water (Figure 6).

The flow of water into the drain is estimated to be 0.70 gpm (Appendix B). Three components of flow were included: (1) regional ground water flow; (2) induced flow due to the trench; and (3) recharge due to precipitation and upward flow from the sand and gravel unit, which would be about 1 foot beneath the drain bottom.

lateral?

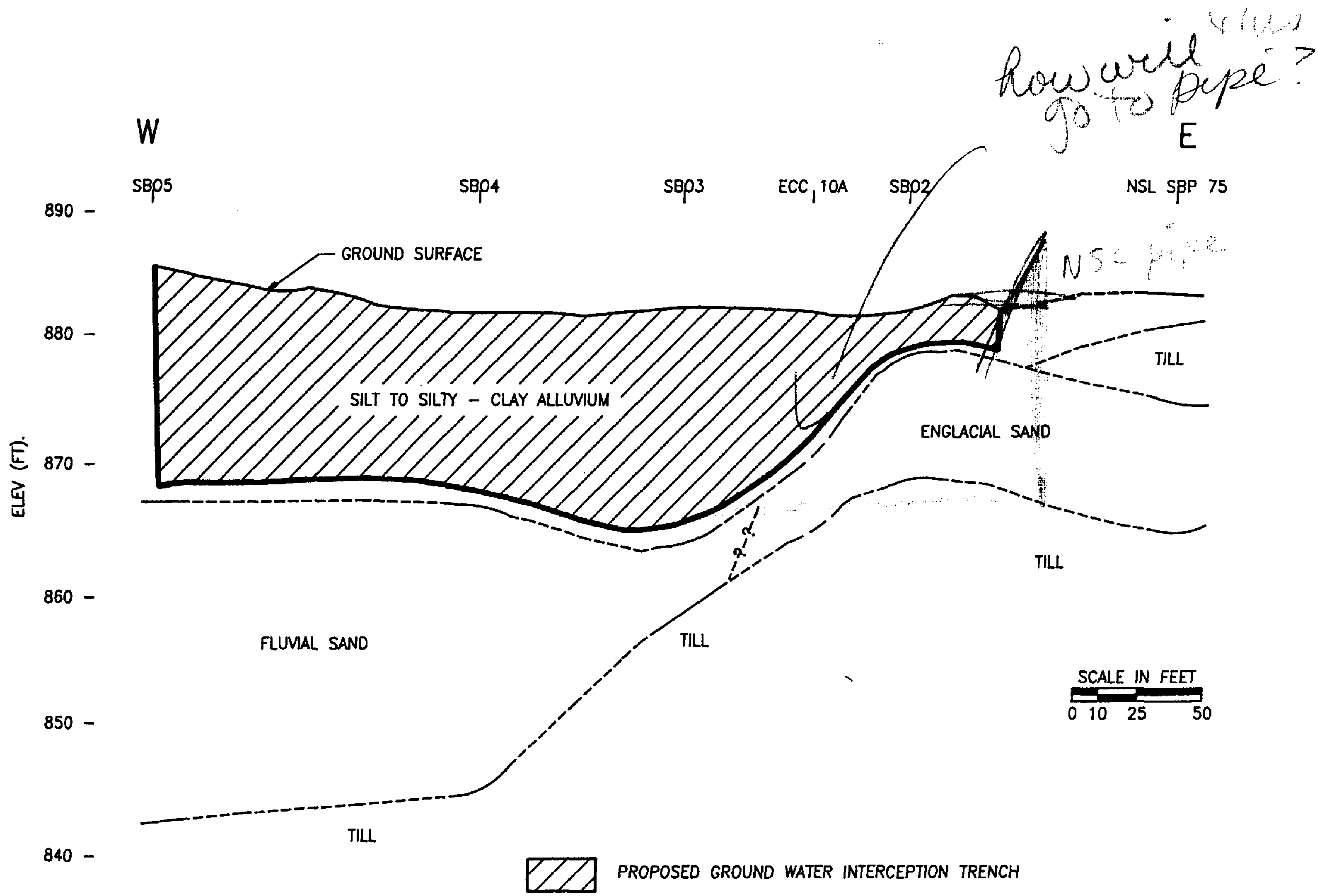
this will go into a 4' drain?

How do they know this



NOTE: NOT TO SCALE

ECC REMEDIAL ACTION PLAN GROUND WATER INTERCEPTION TRENCH	FIGURE 6
ERM ERM–North Central, Inc.	10/27/88 cs



ADAPTED FROM: FIGURE 11A, CH2M-HILL, 1988
DRAFT TECHNICAL MEMORANDUM NO. 2

GEOLOGIC CROSS-SECTION ILLUSTRATING LOCATION OF GROUND WATER INTERCEPTION TRENCH	FIGURE 7
ERM-North Central, Inc.	10/27/88 cs

The water collected in the french drain would then be conveyed to the Indianapolis sewerage system for final treatment.

Water from the ground water interception drain, the trench around the concrete pad and the vapor extraction system would be sampled and analyzed for the TCL parameters weekly, if possible, during the first 2 months after installation to determine the levels of contamination, ~~if any~~, in the collected ground water. Afterwards, a monitoring program would be implemented according to the City of Indianapolis sewerage system requirements.

is there such a thing?

The ground water interception trench would be operated during the same time as the vapor extraction system. After that, the need for continued operation of the interception trench would be assessed based on the volume and quality of the water collected compared to the associated risk, ~~if any~~, using the methodology in the Endangerment Assessment for the site as presented in the RI.

<u>Performance Standards</u>

- ~~prevent contamination, if any, attributable to the ECC site in the surface water south of the site; and~~

- ~~prevent contamination, if any, above endangerment levels in the sand and gravel unit beyond the interception trench.~~

collect contaminated ground water emanating from ECC

6.0 ACCESS RESTRICTIONS

Objectives

- minimize contact with contaminated soils and water containing VOCs, semivolatile organics, and heavy metals; and

- prevent further contaminant migration, ~~if any~~, that could result from site excavation and development.

Description

Access restrictions would consist of:

- fencing around the site perimeter and posting of signs;

- filing of appropriate restrictions with County registrar of deeds prohibiting usage of site for excavation and development;

- filing of appropriate restrictions with County registrar of deeds prohibiting usage of ground water from the saturated till and the underlying sand and gravel; and

- filing of appropriate restrictions with County registrar of deeds prohibiting installation of new water wells other than monitoring wells.

Ground water use restrictions would extend to areas where utilization of the shallow ground water would result in contamination, if ~~any~~, being drawn to these locations.

Neither the saturated surface till nor the sand and gravel unit would predictably nor reliably support water supply development. Therefore, enforcing the restrictions on their use should not be difficult.

Performance Standards

- o the access restrictions to the site soils and ground water would be enforced by the appropriate County officials in accordance with prohibitions described above.

do Co. officials enforce

7.0 GROUND WATER AND SURFACE WATER MONITORING

Objectives

- o detect VOCs migration, ~~if~~ any, to the ground water and surface water; and

- o detect VOCs in the sand and gravel unit, ~~if any~~, that are not captured by the ground water interception system in the surface till.

date of [illegible] response [illegible] working

Description

The ground water monitoring network would consist of three (3) wells, which would be located downgradient of the southern limit of the ECC property and south of the Northside Sanitary Landfill (NSL) access road (Figure 1). These wells would be installed in the sand and gravel unit underlying the saturated surface till. The wells would be 2-in PVC with an anticipated screen length less than or equal to 10 feet. If the sand and gravel unit intercepted by the boring is greater than 10 feet thick, the upper 10 feet would be screened. In cases where the sand and gravel is less than 10 feet thick, the entire sand and gravel interval would be screened.

The location of the monitoring wells is based on the ground water elevation contours shown in Figure 8. As part of the remediation of the NSL site, it is has been proposed that the Unnamed Ditch be isolated in a concrete conduit. Without the Unnamed Ditch as a discharge zone, ground water flow beneath the eastern side of the ECC site will be southerly. Therefore, monitoring wells located south of the site (Figure 1) are appropriate. verify

Samples from these wells would be collected quarterly during site soil remediation and analyzed for the parameters in the Target Compound List (TCL). Once the soil remediation is completed, monitoring will be continued for three (3) years, on a semi-annual basis. Based on the distance to the monitoring wells, three (3) years will be sufficient time for any VOCs that escaped collection by vapor extraction to migrate from underneath the concrete pad to the wells in the sand and gravel unit (Table 3).

The indicator VOC of concern in the sand and gravel unit used for this analysis is trichloroethene (TCE). The travel time for this compound in this unit was estimated assuming a distance of 100 feet from the southern border of the concrete pad to the monitoring wells and permeabilities of 10^{-3} - 10^{-2} cm/sec. With the retardation factor calculated in Appendix C of the RI, the estimated time required for TCE to reach monitoring wells is 0.3-3 years (Table 3).

TCE: 300 yrs

what about northern boundary (refer RI) 5-13

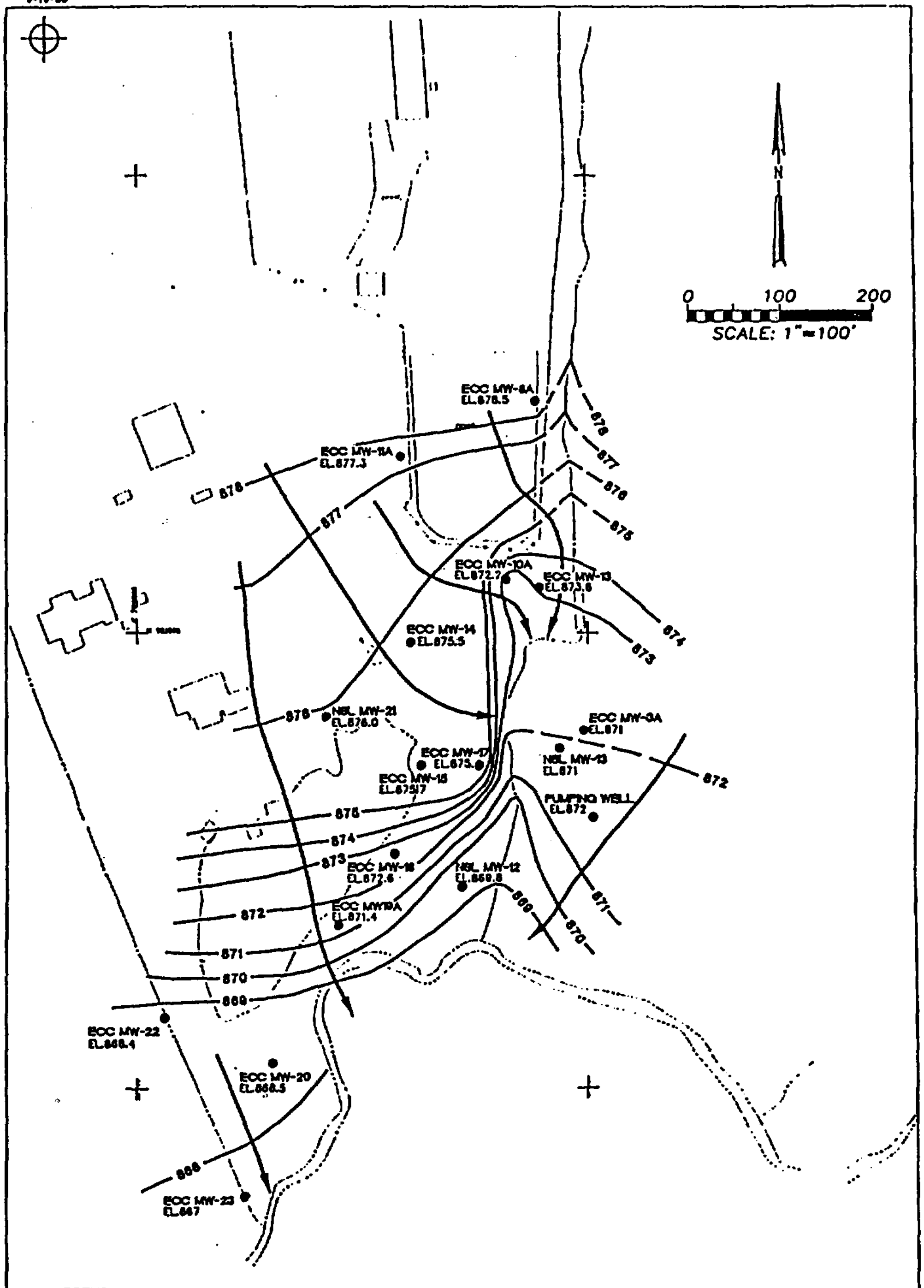
this going to SVE system

TABLE 3

ECC REMEDIAL ACTION PLAN
CALCULATION OF TRAVEL TIME IN THE SAND AND GRAVEL UNIT
BASED ON DATA AND METHODOLOGY IN THE ECC RI

Parameter	TCE
Retardation factor	3.2
Permeability of sand and gravel unit, cm/sec	10^{-3} - 10^{-2}
Ground water velocity, ft/yr	100 - 1,000
Distance to monitoring well from the concrete pad, ft	100
Travel time of compounds to monitoring well, yrs	0.3 - 3

(1) TCE = Trichloroethene



LEGEND

—865— POTENTIOMETRIC SURFACE CONTOUR FOR SAND AND GRAVEL AQUIFER. CONTOUR INTERVAL: 1 FOOT.

— — 865 — — INFERRED POTENTIOMETRIC SURFACE CONTOUR

———▶ DIRECTION OF GROUNDWATER MOVEMENT IN SURFICIAL AQUIFER

NOTE: Contours have been drawn to suggest that the pond is not hydraulically connected to the sand and gravel aquifer. This relationship has not been fully established.

FIGURE 15
POTENTIOMETRIC SURFACE MAP OF
UPPER SAND AND GRAVEL AQUIFER, ECC
APRIL 29, 1988
NSL/ECC TECH MEMO

FIGURE
8

ERM ERM-North Central, Inc.

10/27/88
cs

in a culvert here

The surface water would be monitored by sampling the Unnamed Ditch just south of the NSL access road (Figure 1). Surface water would be sampled at the same frequency as ground water and analyzed for the same parameters.

NO

The concentrations of TCE below which the monitoring would cease for the monitoring wells and the surface water sampling point are based on endangerment levels and the current historical data for the site. The threshold level of TCE for both the surface water sampling point and the monitoring wells would be 100 ug/l. The 100 ug/l level for the surface water sampling point is based on the concentration of TCE that would result in a 6 x 10^{-7} ~~increased carcinogenic risk from wading~~ in Finley Creek (Table E-14 of the RI). Using the same 100 ug/l value for the surface water sampling point and the monitoring wells is very conservative, since it assumes there is no dilution of surface water or ground water upon discharge to Finley Creek or Unnamed Ditch, respectively, in contrast to the 1:2 and 1:600 dilution ratios presented in Table 6-13 of the RI.

NO

The monitoring would cease when the results for two (2) consecutive semi-annual sampling events, after the initial three (3) years of semi-annual sampling, are shown to be statistically significantly below these threshold values. Three (3) years is the longest calculated travel time to the monitoring point for the most significant indicator. not from the northern part

Performance Standards

- o monitoring wells should be operable at all times and inspected quarterly;
- o sampling should be conducted as specified; and

objectives not perf. stds.

- annual summary reports and an analysis of results from each sampling interval should be submitted to the USEPA. + the State

8.0 SCHEDULE

The estimated time required to complete design and implementation phases of the RAP is illustrated in Figure 9. This schedule is based on the number of weeks from a notice to proceed. Tasks to be conducted are:

- soil vapor extraction:
  1) design/installation
  2) operation
- soil capping
- surface water diversion and collection of water from beneath the concrete pad
- ground water interception
- access restrictions
- monitoring:
  1) installation
  2) sampling

Reports which will be prepared for USEPA and state review and comment are:

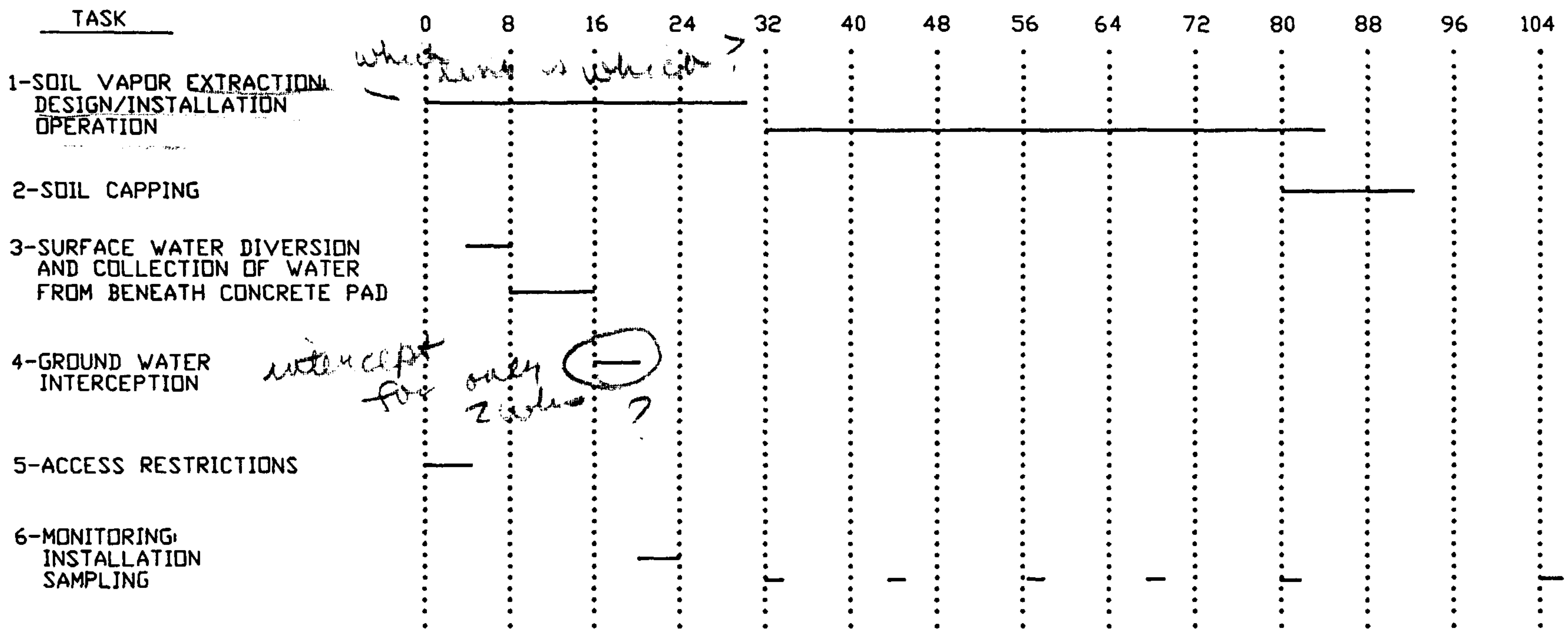
how about approval deadline?

- design document when will this be submitted
- monitoring well installation

QAPP
sampling plan
H+S plan

ESTIMATED PROJECT SCHEDULE

ECC REMEDIAL ACTION WORK PLAN
WEEKS FROM EFFECTIVE DATE OF PLAN APPROVAL



* SAMPLING WOULD BE CONDUCTED SEMIANNUALLY AFTER WEEK 104 FOR A MINIMUM OF 2.5 YEARS. SAMPLING AFTER THAT TIME WOULD BE AS DISCUSSED IN SECTION 7.0.

ECC SITE ESTIMATED PROJECT SCHEDULE	FIGURE 9
ERM ERM–North Central, Inc.	11/3/88 cs

- vapor extraction system installation
- monthly progress reports during soil remediation
- quarterly reports of results of analysis

APPENDIX A

TERRA VAC PILOT TEST
AT
ENVIRONMENTAL CHEMICAL AND CONSERVATION CORP.
ZIONSVILLE, INDIANA

TERRA VAC PILOT TEST
AT
ENVIRONMENTAL CHEMICAL AND CONSERVATION CORP.
ZIONSVILLE, INDIANA

INTRODUCTION

This report discusses the results of the vapor extraction pilot test conducted by Terra Vac with ERM-North Central at the Environmental Chemical and Conservation Corporation (ECC) NPL site in Zionsville, Indiana. The report discusses the major project activities, data gathered, and significant findings in the following sections:

I. Summary
II. System Installation
III. Vapor Extraction Operations
IV. Analytical QA/QC
V. Projection of Clean-Up Time

I. SUMMARY

The vapor extraction pilot test was successful in demonstrating the Terra Vac Process as a technically sound and cost effective method for removing volatile organics from the ECC site soils. Horizontal extraction wells were shown to be superior to vertical extraction wells for the site geology. Clean up time for the site using vapor extraction was estimated to be 300-400 days.

During Terra Vac's pilot test and operating period, approximately 548 pounds of VOCs were removed from the soil at the site. Tests show an approximate 20 foot radius of influence for horizontal extraction wells. The extended run time on HEW-2 developed the data necessary to project clean up time. The vapor extraction operations began on June 13 and continued, with only minor shut downs, until July 20.

II. SYSTEM INSTALLATION

During the week of June 1, Terra Vac personnel arrived on site to receive and procure materials for the job. Trenching began on June 7 and continued until June 8. Subsurface vapor monitoring wells and Vertical Extraction Well (VEW-1) were installed during the remainder of the week. Following extraction trench installation, the major components of the extraction system were manifolded together. Figure 1 is a drawing showing the layout of the test site.

During trench installation soil samples were taken and analyzed for VOCs using the headspace method. As expected, the VOC concentration was highly variable over the length of the trench. Table 1 is a summary of the chemical analyses of the soil samples.

III. VAPOR EXTRACTION OPERATIONS

Appendix A is a daily summary of the system and the operation of each well. Appendix B contains operating and analytical data taken during the pilot test.

A. Well Development

HEW-2 was initially developed for 22 hours. The results of the development period showed high VOC extraction rates and a radius of influence extending to approximately 15 feet. Following development of HEW-2, vapor extraction from HEW-1 and VEW-1 was initiated as a combined development. The combined development continued for approximately four more days. The results of that development period indicated that HEW-1 had lower VOC extraction rates than HEW-2 but a comparable radius of influence. However, no significant radius of influence was measured from the vertical extraction well (VEW-1).

B. Operations

Figure 2 is a plot of the Cumulative Pounds of VOC Extracted by the System versus Run Time. Approximately 548 pounds of VOC were removed from the soil at the site during Terra Vac's operations. After well development, operations focussed on HEW-2, where VOC concentrations were expected and found to be highest. HEW-2 remained in operation for a total of 31.4 days, with a total of 470.8 pounds of VOCs removed, as shown in Figure 3. The radius of influence stabilized at 15 to 20 feet.

Figure 4 and 5 show cumulative VOCs removed from HEW-1 and VEW-1. The short run times reflect both the slow development of VEW-1 and the decision to operate HEW-2 solely. Following development, the unexpectedly high flow rates from HEW-2 necessitated its solo operation so that the pilot system's effectiveness could be maximized.

Figure 6 shows HEW-2 VOC removal rates vs. run time. This type of curve is consistent with Terra Vac's previous experience. Early high rates decline to a relatively stable removal rate that slowly decreases (spikes before day 10 were caused by optimization procedures or short term shutdowns). Figure 7, showing initial and final rates for the major contaminants at HEW-2, indicates how these changes in VOC removal rate occur. There are substantial drops in rates from beginning to end for the more volatile components such as DCE, TCA, and TCE, while rates for Toluene, PCE, and Xylenes have changed little or increased. The Total VOC Removal Rate dropped by 87% from its high point of 76 lb/day to a low point of 9.9 lb/day when the system was shut off.

The extracted VOCs were exhausted using a dispersion stack with agreement from the Indiana Department of Environmental Protection. Air quality testing was performed at the site boundary by ERM-North Central using a hand held vapor analyzer with a photoionization detector. At no time did concentrations of the indicator compounds at the site boundary exceed allowable limits.

IV. ANALYTICAL QA/QC

Several attachments (1-4) are included in this report that outline GC parameters, sampling and QC procedures. Vapor analyses were by direct injection of samples into a Shimadzu GC-9A gas chromatograph equipped with a flame ionization detector and utilizing a capillary column for separation of the compounds. Calibration checks or recalibrations were done daily, prior to sampling. All sample syringes were air purged via pump, with several blanks run to verify efficiency of purging procedure. Questionable results (i.e., an unusual change in concentration) was cause to run a syringe blank and resample to verify initial analysis.

V. PROJECTION OF CLEAN-UP TIME

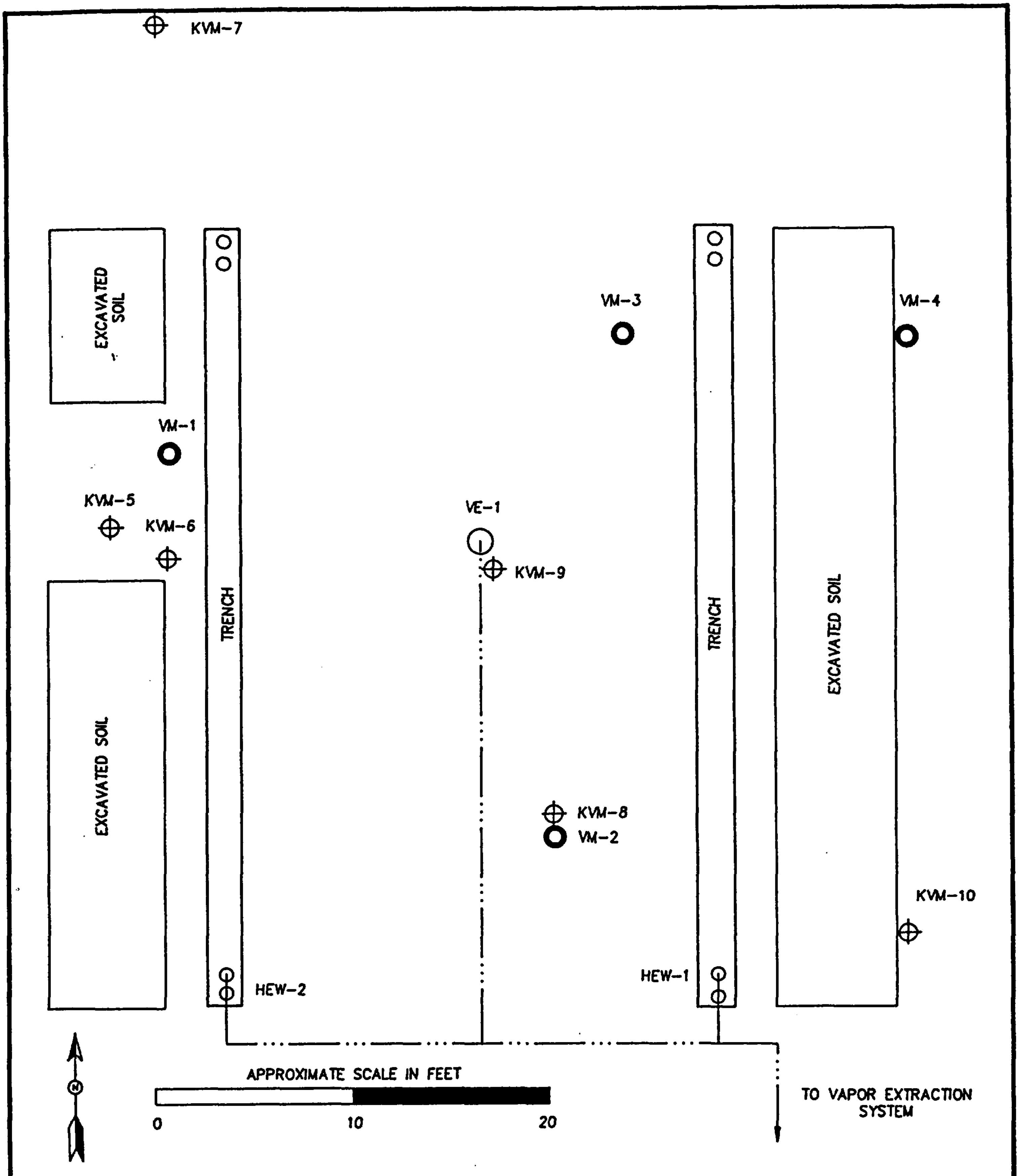
Based upon data collected from the operation of HEW-2, the clean-up time for the site using vapor extraction technology is projected to be approximately 350 days.

TABLE ONE

ECC SOILS DATA
TERRA VAC PILOT TEST

HEW-1	HEW-1	HEW-1	HEW-1	HEW-1	HEW-1	HEW-1		HEW-1	HEW-1
SOIL	SOIL CONCENTRATION (PPM)								
SAMPLE	DEPTH	DCE	TCA	BZ	TCE	TOL	PCE	mp-XYL	TOTAL
ID	FT.	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
T1-3-3	3.0	.2	3.2	NA	7.7	1.9	4.5	1.9	19.4
T1-6-7	7.0	.4	2.4	NA	4.5	2.1	9.6	2.2	9.4
T1-6-9	9.0	.1	.0	NA	.0	.0	.1	.0	.2
T1-12-4	4.0	2.4	59.6	NA	99.7	5.1	187.5	2.3	166.7
T1-12-7	7.0	4.5	63.9	NA	125.0	5.9	155.2	2.2	199.3
T1-20-2	2.0	6.8	18.3	NA	59.0	10.6	2.4	2.9	94.5
T1-25-7	7.0	3.9	8.8	NA	24.5	4.0	11.5	1.7	41.1
T1-35-5	5.0	7.7	45.6	NA	7.9	4.6	4.0	1.8	65.7
T1-35-6	6.0	62.3	96.2	NA	49.7	9.4	103.1	3.8	217.6
T1-40-3	3.0	6.3	4.3	NA	2.0	.5	1.6	.2	13.1
T1-40-5	5.0	1.5	22.4	NA	2.6	1.0	1.1	.5	27.5
T1-40-7	7.0	.7	67.4	NA	9.0	6.9	1.9	.6	84.1

HEW-2	HEW-2		HEW-2	HEW-2	HEW-2	HEW-2	HEW-2	HEW-2	HEW-2
SOIL	SOIL CONCENTRATION (PPM)								
SAMPLE	DEPTH	DCE	TCA	BZ	TCE	TOL	PCE	mp-XYL	TOTAL
ID	FT.	ppm	ppm	ppm	ppm	ppm			ppm
T2-5-3	3.0	.6	3.6	NA	6.5	3.3	1.5	2.3	14.0
T2-5-7	7.0	1.1	180.8	NA	10.6	19.7	4.9	8.8	212.1
T2-5-9	9.0	.2	5.1	NA	8.5	1.2	8.7	1.0	15.0
T2-15-2	2.0	1.5	109.6	NA	6.8	15.3	2.1	3.4	133.2
T2-15-8	8.0	1.1	83.0	NA	16.2	13.8	2.2	4.9	114.1
T2-18-5	5.0	1.1	40.2	NA	12.0	.8	1.9	.1	54.2
T2-22-3	3.0	.4	54.7	NA	20.1	4.0	4.7	1.8	79.1
T2-22-8	8.0	.1	1.8	NA	.7	.4	.2	.2	3.0
T2-35-3	3.0	1.6	37.9	NA	58.7	18.1	26.4	10.1	116.2
T2-35-4	4.0	.6	54.5	NA	333.9	25.5	35.0	6.4	414.4
T2-35-7	7.0	1.4	68.9	NA	71.3	19.2	20.6	13.7	160.7
T2-43-5	5.0	2.5	153.5	NA	24.8	13.3	5.6	5.8	194.1
T2-45-2	2.0	.9	68.9	NA	21.7	12.5	3.8	4.1	103.9
T2-45-6	6.0	1.6	116.8	NA	15.4	14.1	2.5	4.6	147.8



ECC SITE
SOIL VAPOR EXTRACTION SYSTEM
PILOT TEST LAYOUT

FIGURE 1

ERM ERM-North Central, Inc.

mo

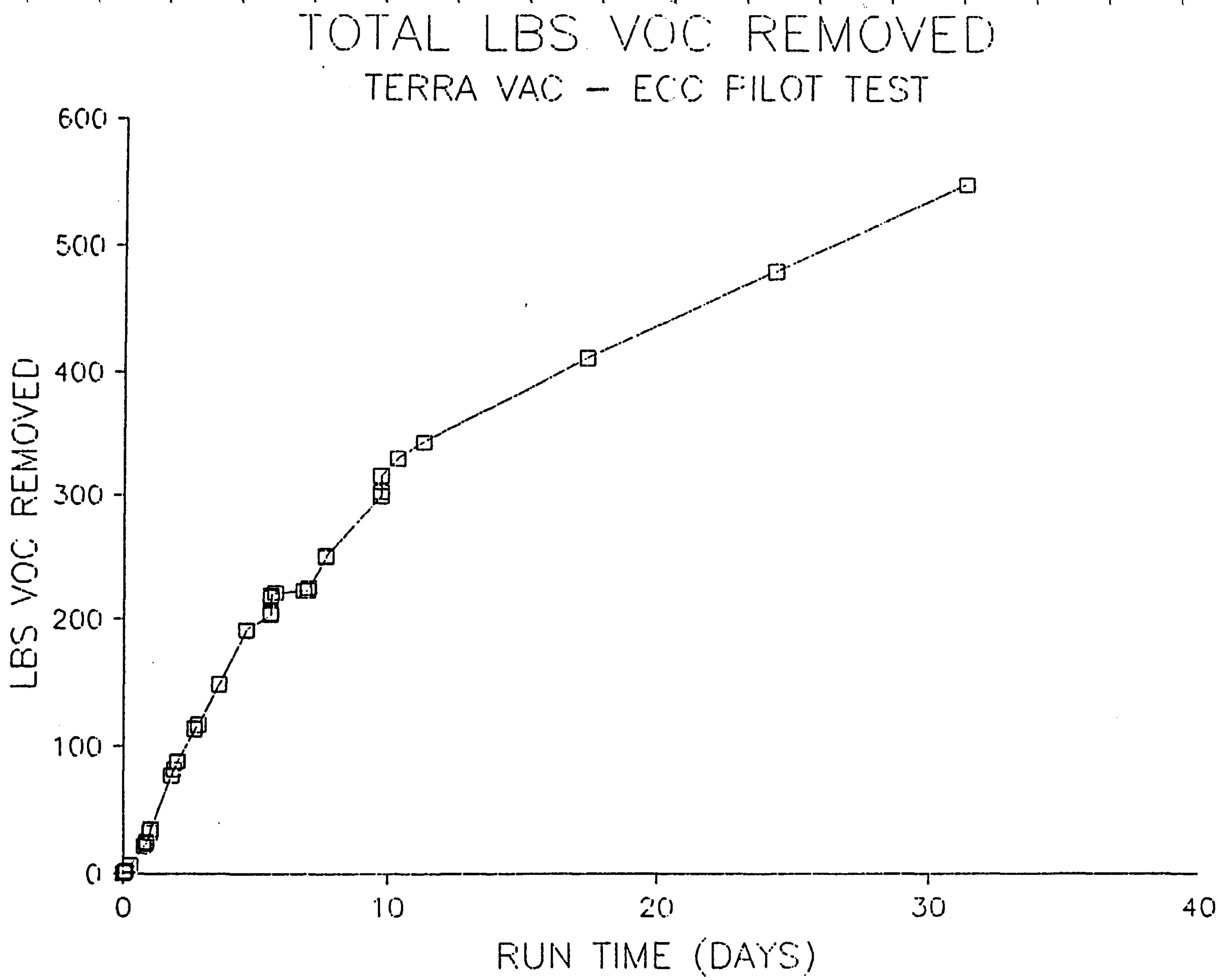
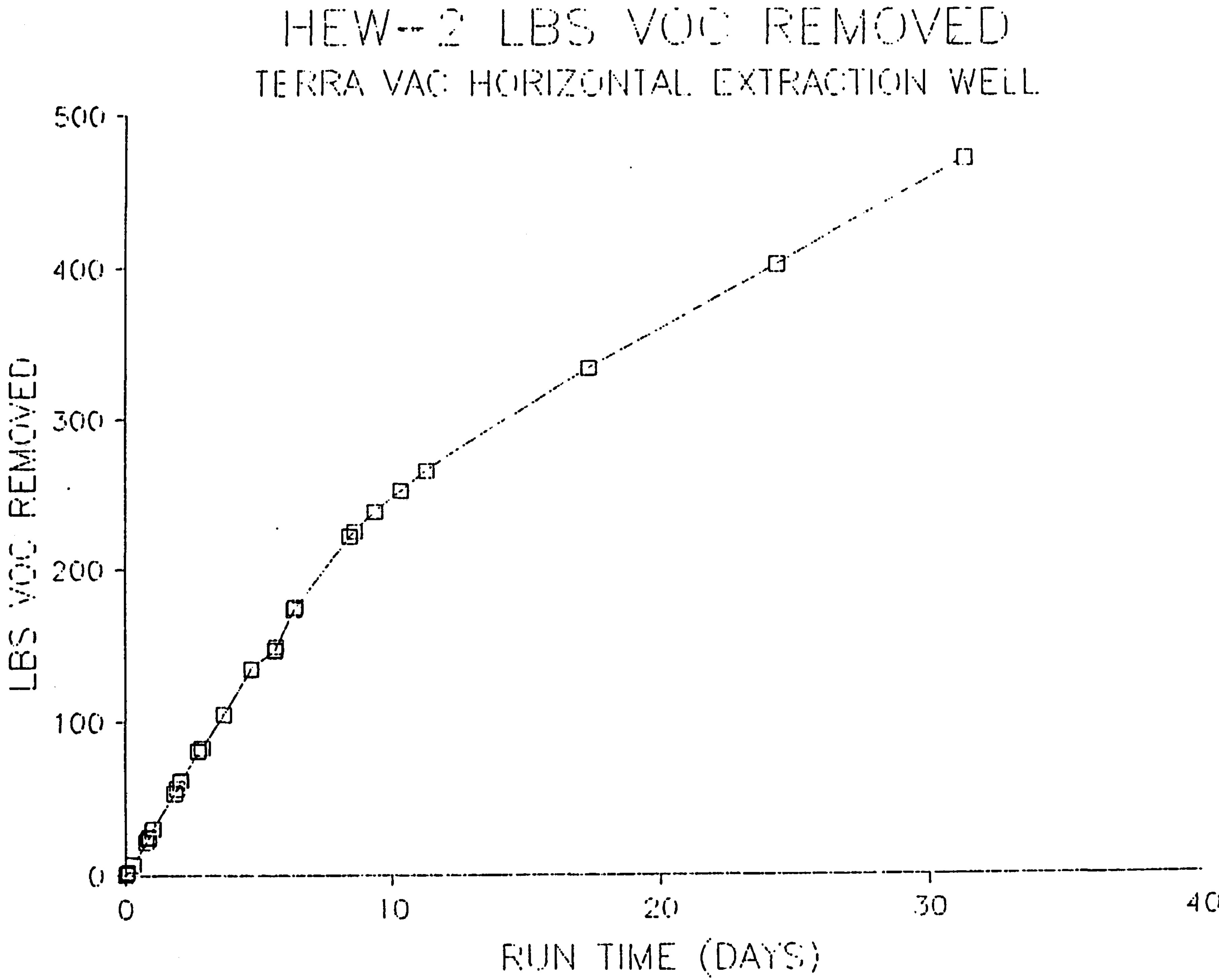

TOTAL LBS VOC REMOVED
TERRA VAC – ECC FILOT TEST
LBS VOC REMOVED
RUN TIME (DAYS)
0
100
200
300
400
500
600
10
20
30
40

FIGURE 2

FIGURE 3


HEW--2 LBS VOC REMOVED
TERRA VAC HORIZONTAL EXTRACTION WELL
LBS VOC REMOVED
500
400
300
200
100
0
0
10
20
30
40
RUN TIME (DAYS)

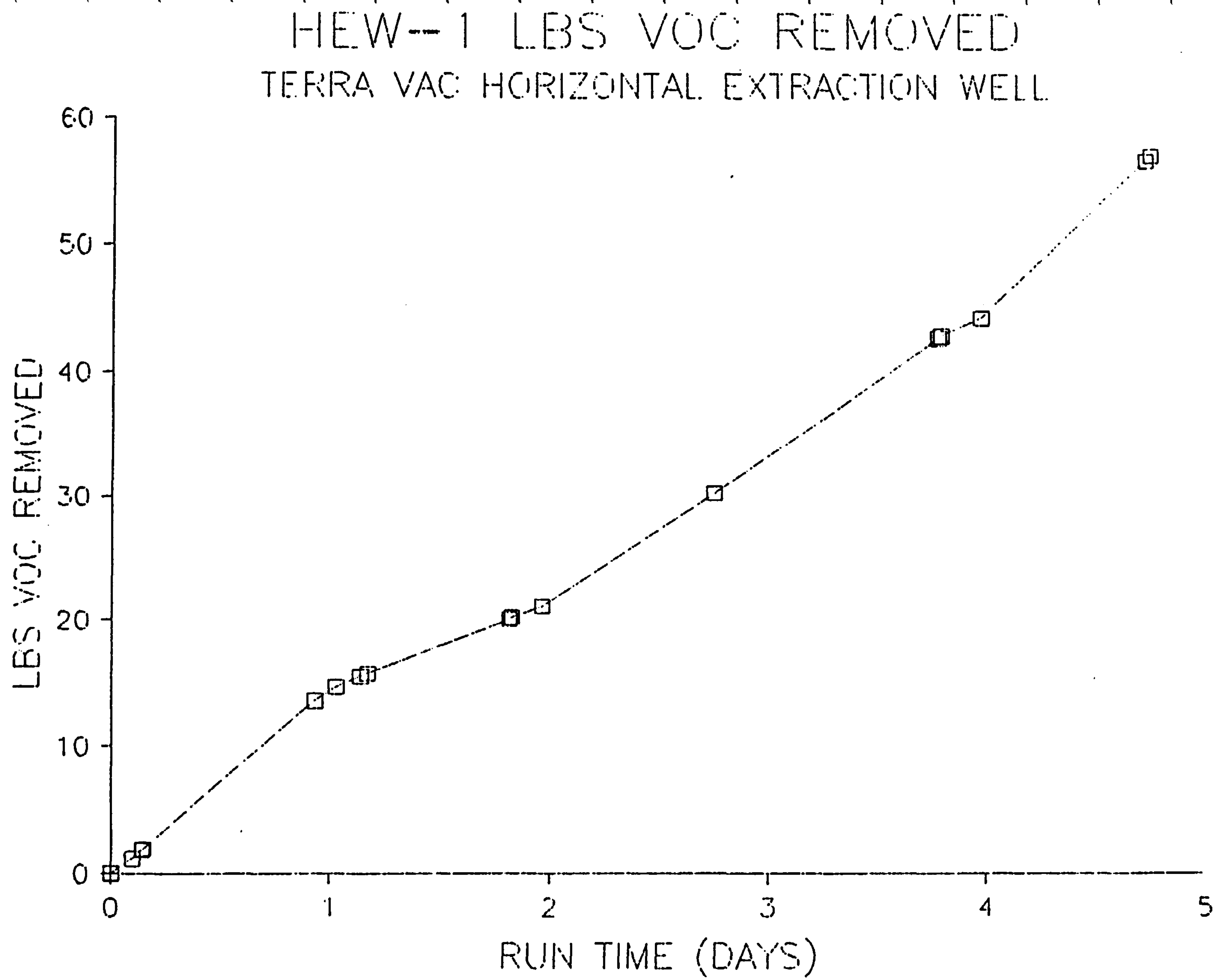
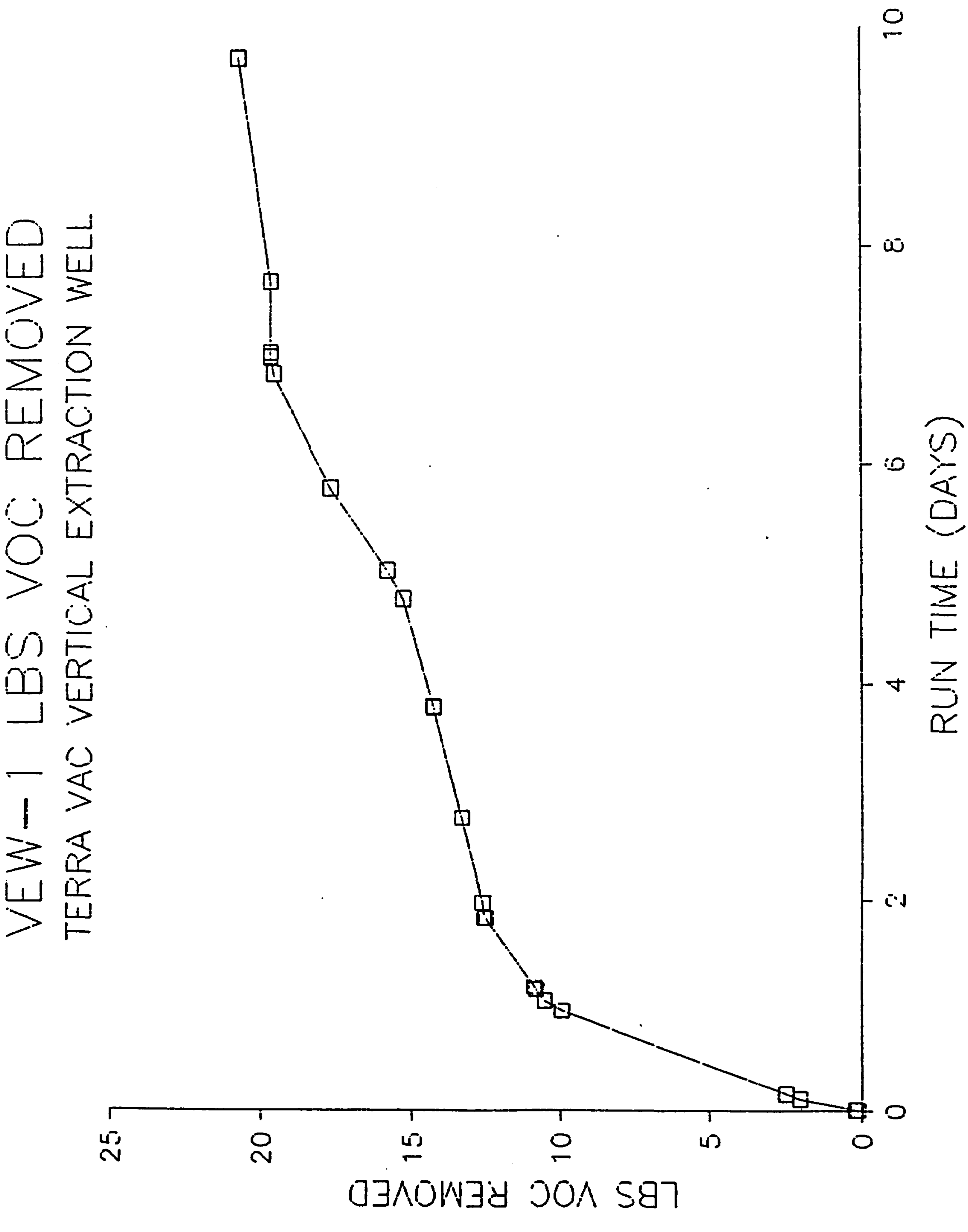

HEW-1 LBS VOC REMOVED
TERRA VAC HORIZONTAL EXTRACTION WELL
LBS VOC REMOVED
RUN TIME (DAYS)
0
10
20
30
40
50
60
0
1
2
3
4
5

FIGURE 4

FIGURE 5


VEW—1 LBS VOC REMOVED
TERRA VAC VERTICAL EXTRACTION WELL
LBS VOC REMOVED
RUN TIME (DAYS)
0
5
10
15
20
25
0
2
4
6
8
10

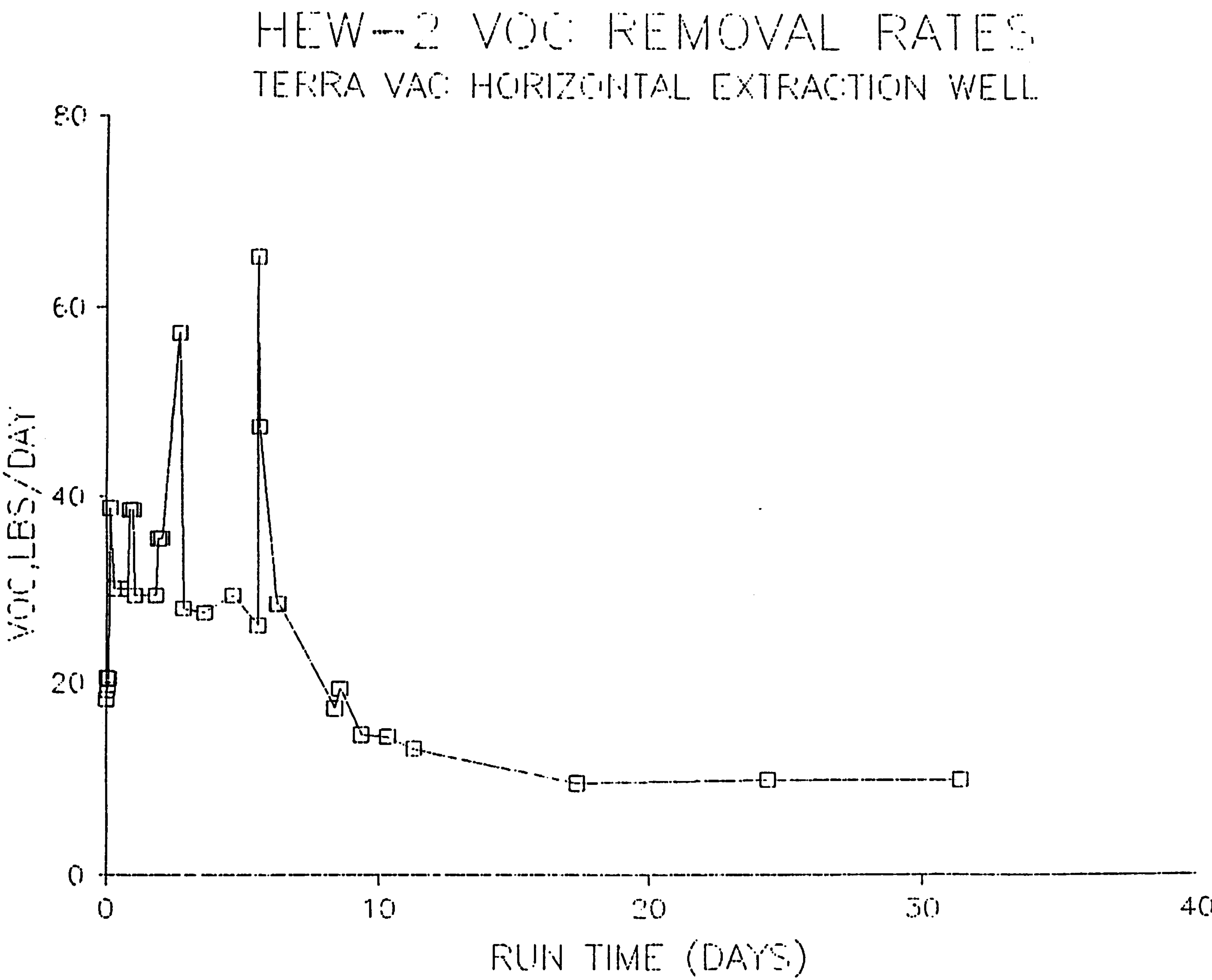

HEW—2 VOC REMOVAL RATES
TERRA VAC HORIZONTAL EXTRACTION WELL
VOC,LBS/DAY
0
20
40
60
80
0
10
20
30
40
RUN TIME (DAYS)

FIGURE 6

HEW-2 INITIAL & FINAL RATES

TERRA VAC HORIZONTAL EXTRACTION WELL

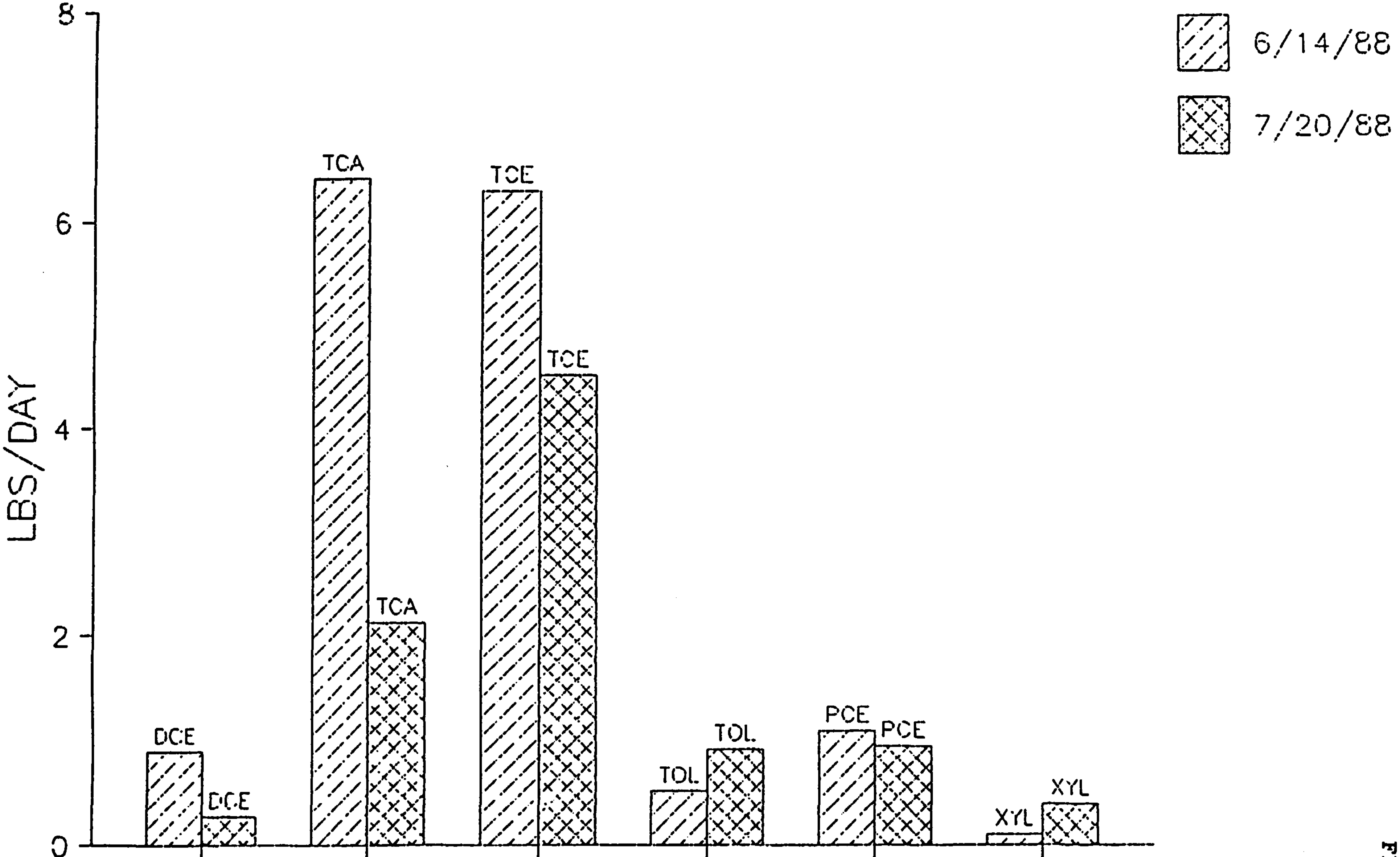


FIGURE 7

APPENDIX A

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

XX SUMMARY - ECC VACUUM EXTRACTION PILOT TEST

SAMPLE TIME DATE	HRS	MIN	XX	RUN TIME (DAYS)	X	FLOW RATE (SCFM)	DCE RATE (#/DY)	TCA RATE (#/DY)	TCE RATE (#/DY)	TOL RATE (#/DY)	PCE RATE (#/DY)	XYL RATE (#/DY)	OTHER RATE (#/DY)	T.VOC RATE (#/DY)	CUM VOC (LBS)
14-Jun	12	17	XX	.00	X	0	0	0	0						0
14-Jun	12	18	XX	.00	X	4	.9	6.4	6.3	.5	1.1	.1	2.9	18.2	
14-Jun	12	38	XX	.01	X	4	.8	10.4	4.7	.7	.7	.1	3.0	20.5	
14-Jun	13	18	XX	.04	X	4	.9	10.3	4.3	.7	.9	.2	1.9	19.2	1
14-Jun	13	31	XX	.05	X	4									1
14-Jun	14	31	XX	.05	X	4									1
14-Jun	15	31	XX	.09	X	4	.7	11.5	4.7	.9	.9	.2	1.5	20.4	1
14-Jun	15	40	XX	.10	X	4									2
14-Jun	16	29	XX	.10	X	4									2
14-Jun	17	29	XX	.14	X	8	1.1	20.7	9.7	1.9	2.1	.6	2.7	38.7	2
14-Jun	20	42	XX	.28	X	8	.8	14.2	8.8	1.6	1.9	.5	2.1	30.1	7
15-Jun	8	39	XX	.77	X	17									22
15-Jun	9	20	XX	.77	X	17									22
15-Jun	11	30	XX	.86	X	17	1.0	15.5	13.4	2.2	3.0	.8	2.6	38.5	24
15-Jun	12	10	XX	.89	X	16								38.5	25
15-Jun	12	23	XX	.90	X	21	3.2	8.0	13.8	.3	1.4		.7	66.1	25
15-Jun	12	27	XX	.90	X	23	.8	2.9	1.5	.1	2.1		1.5	75.1	25
15-Jun	14	50	XX	1.00	X	38	1.3	9.4	5.3	1.0	4.1	.4	2.7	62.8	32
15-Jun	15	55	XX	1.05	X	41	.8	11.3	10.6	1.7	2.4	.5	2.1	53.6	35
15-Jun	16	2	XX	1.05	X	59								53.6	35
16-Jun	10	48	XX	1.83	X	79								53.6	77
16-Jun	13	6	XX	1.93	X	84	1.6	16.6	15.3	2.5	5.3	.8	3.4	45.5	82
16-Jun	15	45	XX	2.04	X	86								45.5	87
16-Jun	16	30	XX	2.07	X	98								45.5	88
16-Jun	19	15	XX	2.07	X	121									88
17-Jun	10	45	XX	2.72	X	191	2.9	23.5	24.4	3.2	8.6	1.0	12.3	75.9	113
17-Jun	11	0	XX	2.73	X	0	1.1	6.3	3.6	.5	3.4	1.0	12.3	75.9	114
17-Jun	11	40	XX	2.73	X	0									114
17-Jun	15	0	XX	2.87	X	202	.7	14.2	14.2	2.1	6.7	.6	3.4	41.9	116

A 2

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

XX SUMMARY - ECC VACUUM EXTRACTION PILOT TEST

SAMPLE TIME DATE	HRS	MIN	XX	RUN TIME (DAYS)	X	FLOW RATE (SCFM)	DCE RATE (#/DY)	TCA RATE (#/DY)	TCE RATE (#/DY)	TOL RATE (#/DY)	PCE RATE (#/DY)	XYL RATE (#/DY)	OTHER RATE (#/DY)	T.VOC RATE (#/DY)	CUM VOC (LBS)
18-Jun	10	0	XX	3.66	X	240	1.2	12.1	13.7	2.1	6.0	.8	2.3	38.3	148
19-Jun	10	30	XX	4.68	X	321	.9	12.8	14.8	2.1	6.9	.8	6.3	44.6	191
19-Jun	10	47	XX	4.69	X	0	.4	5.4	2.6	.4	3.9	.8	6.3	44.6	191
19-Jun	11	40	XX	4.69	X	0									191
20-Jun	9	20	XX	5.59	X	210		5.6	10.5	1.6	2.6	.6	5.2	26.1	203
20-Jun	9	50	XX	5.61	X	0						.6	5.2	26.1	203
20-Jun	10	35	XX	5.61	X	0									203
20-Jun	15	0	XX	5.61	X	141	.5	5.9	2.7	.4	4.9	.1	.5	15.1	205
21-Jun	9	0	XX	5.61	X	185	.4	6.5	3.1	.5	5.7	.2	1.4	17.8	217
21-Jun	9	33	XX	5.61	X	0								17.8	218
21-Jun	10	30	XX	5.61	X	0									218
22-Jun	10	0	XX	5.61	X	4	.1	.7	.9	.1	.1		.1	2.0	219
22-Jun	16	10	XX	5.61	X	4	.1	.8	.9	.1	.2		.2	2.2	219
23-Jun	10	0	XX	5.78	X	4	.1	1.1	1.1	.1	.2		.3	2.9	221
24-Jun	11	0	XX	6.82	X	4		.3	.3				.1	.7	223
24-Jun	14	30	XX	6.97	X	5		.3	.3				.1	.7	223
24-Jun	16	34	XX	6.97	X	4									223
24-Jun	16	50	XX	6.98	X	209	1.3	26.6	18.9	3.2	5.6	1.4	8.3	65.2	223
24-Jun	17	35	XX	7.01	X	209	1.0	17.5	16.1	2.7	4.6	1.1	4.5	47.4	225
25-Jun	9	15	XX	7.66	X	237	.6	7.0	10.9	1.6	2.5	.6	5.3	28.4	250
25-Jun	10	30	XX	7.66	X	237	.6	7.0	10.9	1.6	2.5	.6	5.3	28.4	251
27-Jun	11	30	XX	9.70	X	319	.4	3.8	8.1	1.6	1.8	.5	2.1	18.3	299
27-Jun	11	45	XX	9.71	X	319	.4	3.4	7.8	1.5	1.8	.5	2.0	18.3	299
27-Jun	16	0	XX	9.71	X	320	.4	3.3	8.0	1.6	1.8	.5	3.7	19.3	302
28-Jun	10	35	XX	9.71	X	322	.3	2.8	6.7	1.4	1.6	.5	1.3	14.5	315
29-Jun	10	0	XX	10.34	X	324	.3	2.6	6.1	1.3	1.5	.5	2.1	14.3	330
30-Jun	9	15	XX	11.31	X	327	.3	2.4	5.6	1.1	1.3	.4	2.0	13.1	343
06-Jul	11	0	XX	17.38	X	362	.3	2.2	4.6	.8	.8	.3	.5	9.5	412
13-Jul	11	0	XX	24.38	X	347	.3	2.1	4.5	.9	1.0	.4	.7	9.9	479
20-Jul	10	40	XX	31.37	X	346								9.9	548

A3

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

			XX	HORIZONTAL EXTRACTION WELL - HEW-2										HEW-2	
SAMPLE TIME			XX			<<<	OPERATING SUMMARY				>>>				
			XX	RUN	FLOW	TOTAL	DCE	TCA	TCE	TOL	PCE	XYL	OTHER	T.VOC	CUM
			XX	TIME	RATE	VOC	RATE	RATE	RATE	RATE	RATE	RATE	RATE	RATE	VOC
DATE	HRS	MIN	XX	(DYS)	(SCFM)	(mg/1)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(LBS)
14-Jun	12	17	XX		0										0
14-Jun	12	18	XX		4	49.9	.9	6.4	6.3	.5	1.1	.1	2.9	18.2	
14-Jun	12	38	XX		4	55.9	.8	10.4	4.7	.7	.7	.1	3.0	20.5	.3
14-Jun	13	18	XX		4	52.5	.9	10.3	4.3	.7	.9	.2	1.9	19.2	.8
14-Jun	13	31	XX	.1	4							.2	1.9	19.2	1.0
14-Jun	14	31	XX	.1	4										1.0
14-Jun	15	31	XX	.1	4	52.5	.7	11.5	4.7	.9	.9	.2	1.5	20.4	1.4
14-Jun	15	40	XX	.1	4							.2	1.5	20.4	1.6
14-Jun	16	29	XX	.1	4										1.6
14-Jun	17	29	XX	.1	8	51.1	1.1	20.7	9.7	1.9	2.1	.6	2.7	38.7	2.4
14-Jun	20	42	XX	.3	8	40.1	.8	14.2	8.8	1.6	1.9	.5	2.1	30.1	7.0
15-Jun	8	39	XX	.8	17	51.1	1.1	20.7	9.7	1.9	2.1	.5	2.1	30.1	21.9
15-Jun	9	20	XX	.8	17										21.9
15-Jun	11	30	XX	.9	17	25.7	1.0	15.5	13.4	2.2	3.0	.8	2.6	38.5	23.7
15-Jun	12	10	XX	.9	16									38.5	24.7
15-Jun	12	23	XX	.9	16									38.5	25.1
15-Jun	12	27	XX	.9	17									38.5	25.2
15-Jun	14	50	XX	1.0	17									38.5	29.0
15-Jun	15	55	XX	1.0	17	19.8	.8	11.3	10.6	1.7	2.4	.5	2.1	29.3	30.6
15-Jun	16	2	XX	1.1	25									29.3	30.7
16-Jun	10	48	XX	1.8	33									29.3	53.6
16-Jun	13	6	XX	1.9	38	10.5	1.0	12.8	13.7	2.0	3.0	.6	2.3	35.4	56.7
16-Jun	15	45	XX	2.0	38									35.4	60.7
16-Jun	16	30	XX	2.1	44									35.4	61.8
16-Jun	19	15	XX	2.1	54										61.8
17-Jun	10	45	XX	2.7	106	6.0	1.8	17.2	20.8	2.7	5.3	.9	8.8	57.4	80.3
17-Jun	11	0	XX	2.7	0							.9	8.8	57.4	80.9
17-Jun	11	40	XX	2.7	0										80.9
17-Jun	15	0	XX	2.9	115	2.7		8.9	12.0	1.6	3.1	.4	1.9	27.9	82.8

A4

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

SAMPLE TIME			XX	HORIZONTAL EXTRACTION WELL - HEW-2										HEW-2	
			XX			<<<	OPERATING SUMMARY				>>>				
DATE	HRS	MIN	XX	RUN TIME (DYS)	FLOW RATE (SCFM)	TOTAL VOC (mg/l)	DCE RATE (#/DY)	TCA RATE (#/DY)	TCE RATE (#/DY)	TOL RATE (#/DY)	PCE RATE (#/DY)	XYL RATE (#/DY)	OTHER RATE (#/DY)	T.VOC RATE (#/DY)	CUM VOC (LBS)
18-Jun	10	0	XX	3.7	146	2.1	.7	7.7	11.7	1.8	3.2	.6	1.7	27.5	104.7
19-Jun	10	30	XX	4.7	202	1.6	.5	7.4	12.2	1.8	2.9	.7	3.9	29.3	133.7
19-Jun	10	47	XX	4.7	0							.7	3.9	29.3	134.0
19-Jun	11	40	XX	4.7	0										134.0
20-Jun	9	20	XX	5.6	210	1.4		5.6	10.5	1.6	2.6	.6	5.2	26.1	145.8
20-Jun	9	50	XX	5.6	0							.6	5.2	26.1	146.4
20-Jun	10	35	XX	5.6	0										146.4
20-Jun	15	0	XX	5.6	0										146.4
21-Jun	9	0	XX	5.6	0										146.4
21-Jun	9	33	XX	5.6	0										146.4
21-Jun	10	30	XX	5.6	0										146.4
22-Jun	10	0	XX	5.6	0										146.4
22-Jun	16	10	XX	5.6	0										146.4
23-Jun	10	0	XX	5.6	0										146.4
24-Jun	11	0	XX	5.6	0										146.4
24-Jun	14	30	XX	5.6	0										146.4
24-Jun	16	34	XX	5.6	0										146.4
24-Jun	16	50	XX	5.6	205	3.6	1.3	26.6	18.9	3.2	5.6	1.4	8.3	65.2	146.7
24-Jun	17	35	XX	5.7	205	2.6	1.0	17.5	16.1	2.7	4.6	1.1	4.5	47.4	148.5
25-Jun	9	15	XX	6.3	233	1.4	.6	7.0	10.9	1.6	2.5	.6	5.3	28.4	173.2
25-Jun	10	30	XX	6.4	233	1.4	.6	7.0	10.9	1.6	2.5	.6	5.3	28.4	174.7
27-Jun	11	30	XX	8.4	315	.6	.4	3.4	7.8	1.5	1.8	.5	2.0	17.3	221.4
27-Jun	11	45	XX	8.4	315	.6	.4	3.4	7.8	1.5	1.8	.5	2.0	17.3	221.5
27-Jun	16	0	XX	8.6	315	.7	.4	3.3	8.0	1.6	1.8	.5	3.7	19.3	224.8
28-Jun	10	35	XX	9.4	318	.5	.3	2.8	6.7	1.4	1.6	.5	1.3	14.5	237.9
29-Jun	10	0	XX	10.3	320	.5	.3	2.6	6.1	1.3	1.5	.5	2.1	14.3	252.0
30-Jun	9	15	XX	11.3	323	.5	.3	2.4	5.6	1.1	1.3	.4	2.0	13.1	265.3
06-Jul	11	0	XX	17.4	357	.3	.3	2.2	4.6	.8	.8	.3	.5	9.5	334.0
13-Jul	11	0	XX	24.4	343	.3	.3	2.1	4.5	.9	1.0	.4	.7	9.9	401.9
20-Jul	10	40	XX	31.4	341									9.9	470.8

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

SAMPLE TIME			XX	HORIZONTAL EXTRACTION WELL - HEW-1										HEW-1	
			XX			<<<	OPERATING SUMMARY			>>>					
			XX	RUN TIME	FLOW RATE	TOTAL VOC	DCE RATE	TCA RATE	TCE RATE	TOL RATE	PCE RATE	XYL RATE	OTHER RATE	T.VOC RATE	CUM VOC
DATE	HRS	MIN	XX	(DYS)	(SCFM)	(mg/l)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(LBS)
14-Jun	12	17	XX												
14-Jun	12	18	XX												
14-Jun	12	38	XX												
14-Jun	13	18	XX												
14-Jun	13	31	XX												
14-Jun	14	31	XX												
14-Jun	15	31	XX												
14-Jun	15	40	XX												
14-Jun	16	29	XX												
14-Jun	17	29	XX												
14-Jun	20	42	XX												
15-Jun	8	39	XX												
15-Jun	9	20	XX												
15-Jun	11	30	XX												
15-Jun	12	10	XX												
15-Jun	12	23	XX											.00	
15-Jun	12	27	XX		2	58.74	.8	2.9	1.5	.1	2.1		1.47	8.9	
15-Jun	14	50	XX	.1	17	9.97	.9	5.2	2.3	.7	3.7	.3	1.70	14.8	1.2
15-Jun	15	55	XX	.1	17									14.8	1.9
15-Jun	16	2	XX	.2	25									14.8	1.9
16-Jun	10	48	XX	.9	33									14.8	13.5
16-Jun	13	6	XX	1.0	34	2.50	.5	2.8	1.2	.3	2.1	.1	.62	7.5	14.5
16-Jun	15	45	XX	1.1	34									7.5	15.4
16-Jun	16	30	XX	1.2	39									7.5	15.6
16-Jun	19	15	XX	1.2	52										15.6
17-Jun	10	45	XX	1.8	68	2.23	.8	4.6	1.9	.3	3.0	.1	3.00	13.6	20.0
17-Jun	11	0	XX	1.8		2.23	.8	4.6	1.9	.3	3.0	.1	3.00	13.6	20.1
17-Jun	11	40	XX	1.8											20.1
17-Jun	15	0	XX	2.0	82	1.78	.7	4.9	2.0	.4	3.6	.2	1.44	13.1	21.0

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

			XX	HORIZONTAL EXTRACTION WELL - HEW-1										HEW-1	
SAMPLE TIME			XX			<<<	OPERATING SUMMARY				>>>				
			XX	RUN	FLOW	TOTAL	DCE	TCA	TCE	TOL	PCE	XYL	OTHER	T.VOC	CUM
			XX	TIME	RATE	VOC	RATE	RATE	RATE	RATE	RATE	RATE	RATE	RATE	VOC
DATE	HRS	MIN	XX	(DYS)	(SCFM)	(mg/1)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(#/DY)	(LBS)
18-Jun	10	0	XX	2.8	90	1.24	.5	4.1	1.8	.3	2.8	.1	.50	10.0	30.2
19-Jun	10	30	XX	3.8	114	1.40	.4	5.0	2.4	.3	3.9	.1	2.29	14.3	42.6
19-Jun	10	47	XX	3.8		1.40	.4	5.0	2.4	.3	3.9	.1	2.29	14.3	42.7
19-Jun	11	40	XX	3.8											42.7
20-Jun	9	20	XX	3.8											42.7
20-Jun	9	50	XX	3.8											42.7
20-Jun	10	35	XX	3.8											42.7
20-Jun	15	0	XX	4.0	141	1.20	.5	5.9	2.7	.4	4.9	.1	.49	15.1	44.1
21-Jun	9	0	XX	4.7	185	1.08	.4	6.5	3.1	.5	5.7	.2	1.37	17.8	56.5
21-Jun	9	33	XX	4.7										17.8	56.9
21-Jun	10	30	XX	4.7											56.9
22-Jun	10	0	XX	4.7											56.9
22-Jun	16	10	XX	4.7											56.9
23-Jun	10	0	XX	4.7											56.9
24-Jun	11	0	XX	4.7											56.9
24-Jun	14	30	XX	4.7											56.9
24-Jun	16	34	XX	4.7											56.9
24-Jun	16	50	XX	4.7											56.9
24-Jun	17	35	XX	4.7											56.9
25-Jun	9	15	XX	4.7											56.9
25-Jun	10	30	XX	4.7											56.9
27-Jun	11	30	XX	4.7											56.9
27-Jun	11	45	XX	4.7											56.9
27-Jun	16	0	XX	4.7											56.9
28-Jun	10	35	XX	4.7											56.9
29-Jun	10	0	XX	4.7											56.9
30-Jun	9	15	XX	4.7											56.9
06-Jul	11	0	XX	4.7											56.9
13-Jul	11	0	XX	4.7											56.9
20-Jul	10	40	XX	4.7											56.9

A 7

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

			XX	VERTICAL EXTRACTION WELL - VE-1										VE-1	
SAMPLE TIME			XX			<<< OPERATING SUMMARY >>>									
DATE	HRS	MIN	XX	RUN TIME (DYS)	FLOW RATE (SCFM)	TOTAL VOC (mg/1)	DCE RATE (#/DY)	TCA RATE (#/DY)	TCE RATE (#/DY)	TOL RATE (#/DY)	PCE RATE (#/DY)	XYL RATE (#/DY)	OTHER RATE (#/DY)	T.VOC RATE (#/DY)	CUM VOC (LBS)
14-Jun	12	17	XX												
14-Jun	12	18	XX												
14-Jun	12	38	XX												
14-Jun	13	18	XX												
14-Jun	13	31	XX												
14-Jun	14	31	XX												
14-Jun	15	31	XX												
14-Jun	15	40	XX												
14-Jun	16	29	XX												
14-Jun	17	29	XX												
14-Jun	20	42	XX												
15-Jun	8	39	XX												.00
15-Jun	9	20	XX												
15-Jun	11	30	XX												
15-Jun	12	10	XX												
15-Jun	12	23	XX		4	73.67	3.2	8.0	13.8	.3	1.4		.7	27.6	.1
15-Jun	12	27	XX		4									27.6	.2
15-Jun	14	50	XX	.1	4	25.36	.4	4.2	3.0	.4	.4	.1	1.0	9.5	2.0
15-Jun	15	55	XX	.2	8									9.5	2.5
15-Jun	16	2	XX	.2	8									9.5	2.5
16-Jun	10	48	XX	.9	13									9.5	10.0
16-Jun	13	6	XX	1.0	13	2.18	.1	1.0	.5	.3	.1		.5	2.5	10.5
16-Jun	15	45	XX	1.1	15									2.5	10.8
16-Jun	16	30	XX	1.2	15									2.5	10.9
16-Jun	19	15	XX	1.2	15										10.9
17-Jun	10	45	XX	1.8	17	3.31	.3	1.7	1.7	.3	.3	.1	.5	5.0	12.5
17-Jun	11	0	XX	1.8		3.31	.3	1.7	1.7	.3	.3	.1	.5	5.0	12.5
17-Jun	11	40	XX	1.8											12.5
17-Jun	15	0	XX	2.0	4	2.53	.1	.4	.2	.1			.1	.9	12.6

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

SAMPLE TIME			XX	VERTICAL EXTRACTION WELL - VE-1										VE-1	
			XX			<<< OPERATING SUMMARY >>>									
DATE	HRS	MIN	XX	RUN TIME (DYS)	FLOW RATE (SCFM)	TOTAL VOC (mg/1)	DCE RATE (#/DY)	TCA RATE (#/DY)	TCE RATE (#/DY)	TOL RATE (#/DY)	PCE RATE (#/DY)	XYL RATE (#/DY)	OTHER RATE (#/DY)	T.VOC RATE (#/DY)	CUM VOC (LBS)
18-Jun	10	0	XX	2.8	4	2.21	.1	.4	.2	.1			.1	.9	13.3
19-Jun	10	30	XX	3.8	4	2.55		.4	.3	.1			.1	1.0	14.3
19-Jun	10	47	XX	3.8		2.55		.4	.3	.1			.1	1.0	14.3
19-Jun	11	40	XX	3.8											14.3
20-Jun	9	20	XX	3.8											14.3
20-Jun	9	50	XX	3.8											14.3
20-Jun	10	35	XX	3.8											14.3
20-Jun	15	0	XX	3.8											14.3
21-Jun	9	0	XX	3.8											14.3
21-Jun	9	33	XX	3.8											14.3
21-Jun	10	30	XX	3.8											14.3
22-Jun	10	0	XX	4.8	4	6.35	.1	.7	.9	.1	.1		.1	2.0	15.3
22-Jun	16	10	XX	5.0	4	6.78	.1	.8	.9	.1	.2		.2	2.2	15.8
23-Jun	10	0	XX	5.8	4	8.89	.1	1.1	1.1	.1	.2		.3	2.9	17.7
24-Jun	11	0	XX	6.8	4	2.10		.3	.3				.1	.7	19.5
24-Jun	14	30	XX	7.0	5	2.10		.3	.3				.1	.7	19.6
24-Jun	16	34	XX	7.0	4										19.6
24-Jun	16	50	XX	7.0	4										19.6
24-Jun	17	35	XX	7.0	4										19.6
25-Jun	9	15	XX	7.7	4										19.6
25-Jun	10	30	XX	7.7	4										19.6
27-Jun	11	30	XX	9.7	4	2.55		.4	.3	.1			.1	1.0	20.7
27-Jun	11	45	XX	9.7	4									1.0	20.7
27-Jun	16	0	XX	9.7	4										20.7
28-Jun	10	35	XX	9.7	4										20.7
29-Jun	10	0	XX	9.7	4										20.7
30-Jun	9	15	XX	9.7	4										20.7
06-Jul	11	0	XX	9.7	4										20.7
13-Jul	11	0	XX	9.7	4										20.7
20-Jul	10	40	XX	9.7	4										20.7

APPENDIX B

TERRA VAC/ ECC - ERN SITE / PROJECT 88-304

HORIZONTAL EXTRACTION WELL - HEW-2 / HEW-2

SAMPLE TIME			<< OPERATION DATA >>					<< GAS CHROMATOGRAPH READOUT >>							<< WELLHEAD CONCENTRATION >>						
				INJ	WELL	FLOW	FLOW	1,1	1,1,1				N.P-	TOTAL	1.1	1,1,1				N.P-	
			SAMP	VOL	VAC	RATE	RATE	DCE	TCA	TCE	TOL	PCE	ETL	AREA	DCE	TCA	TCE	TOL	PCE	ETL	OTHER
DATE	HRS	MIN	NUM	(ul)	("Hg)	(SCFM)	(ACFM)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	1000X	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)
14-Jun	12	17	777											0							
14-Jun	12	18	106	100	10.0	4	5	.163	1.170	1.150	.094	.200	.019	1020	2.445	17.55	17.25	1.410	3.000	.285	7.92
14-Jun	12	38	107	100	10.0	4	5	.146	1.850	.863	.121	.109	.024	1105	2.190	28.35	12.95	1.815	1.995	.360	8.27
14-Jun	13	18	108	100	10.0	4	5	.162	1.870	.791	.129	.132	.031	930	2.430	28.05	11.87	1.935	2.445	.465	5.31
14-Jun	13	31	999	100	10.0	4	5														
14-Jun	14	31	777	100	10.0	4	5														
14-Jun	15	31	109	100	7.5	4	5	.128	2.216	.903	.171	.131	.048	990	1.707	29.55	12.04	2.280	2.387	.640	3.94
14-Jun	15	40	999	100	8.0	4	5														
14-Jun	16	29	777	100	9.0	4	5														
14-Jun	17	29	110	100	8.5	8	10	.103	1.953	.915	.182	.138	.057	928	1.437	27.25	12.77	2.540	2.721	.795	3.55
14-Jun	20	42	111	100	9.0	8	10	.077	1.328	.823	.152	.130	.051	728	1.100	18.97	11.76	2.171	2.566	.729	2.78
15-Jun	8	39	999	100	9.3	17	20														
15-Jun	9	20	777	100	9.0	17	20														
15-Jun	11	30	112	100	9.0	17	20	.046	.724	.626	.104	.104	.036	475	.657	10.34	8.94	1.486	2.000	.514	1.76
15-Jun	12	10	868	100	10.0	16	20														
15-Jun	12	23	888	100	10.0	16	20														
15-Jun	12	27	666	100	9.0	17	20														
15-Jun	14	50	888	100	8.5	17	20														
15-Jun	15	55	117	100	9.5	17	20	.036	.520	.451	.077	.084	.025	358	.527	7.610	7.155	1.127	1.595	.366	1.39
15-Jun	16	2	888	100	8.5	25	30														
16-Jun	10	48	868	100	9.0	33	40														
16-Jun	13	6	120	100	9.1	38	45	.020	.266	.283	.042	.051	.012	191	.287	3.818	4.062	.603	.904	.172	.68
16-Jun	15	45	888	100	9.0	38	45														
16-Jun	16	30	999	100	1.0	44	45														
16-Jun	19	15	777	100	12.0	54	70														
17-Jun	10	45	125	100	7.8	106	123	.014	.134	.162	.021	.034	.007	143	.189	1.811	2.169	.284	.554	.095	.53
17-Jun	11	0	999	100	1.0	0															
17-Jun	11	40	777	100	1.0	0															
17-Jun	15	0	129	100	9.0	115	138	ND	.060	.081	.011	.018	.003	50		.857	1.157	.157	.300	.043	.18

HORIZONTAL EXTRACTION WELL - HEW-2 | HEW-2

SAMPLE TIME				<< OPERATION DATA >>					<< GAS CHROMATOGRAPH READOUT >>								<< WELLHEAD CONCENTRATION >>						
				INJ	WELL	FLOW	FLOW		1,1	1,1,1				M,P-	TOTAL		1,1	1,1,1				M,P-	
			SAMP	VOL	VAC	RATE	RATE		DCE	TCA	TCE	TOL	PCE	XYL	AREA		DCE	TCA	TCE	TOL	PCE	XYL	OTHER
DATE	HRS	MIN	NUM	(ul)	("Hg)	(SCFM)	(ACFM)		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	1000X		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
18-Jun	10	0	133	500	6.3	146	164		.021	.232	.354	.054	.079	.019	223		.053	.587	.856	.137	.248	.048	.13
19-Jun	10	30	136	500	5.8	202	225		.012	.164	.271	.039	.050	.015	199		.030	.407	.672	.097	.161	.037	.21
19-Jun	10	47	999	100	1.0	0																	
19-Jun	11	40	777	100	1.0	0																	
20-Jun	9	20	137	500	7.0	210	240		nd	.115	.214	.032	.040	.012	188			.300	.558	.083	.136	.031	.28
20-Jun	9	50	999	100	1.0	0																	
20-Jun	10	35		100	1.0	0																	
20-Jun	15	0		100	1.0	0																	
21-Jun	9	0		100	1.0	0																	
21-Jun	9	33		100	1.0	0																	
21-Jun	10	30		100	1.0	0																	
22-Jun	10	0		100	1.0	0																	
22-Jun	16	10		100	1.0	0																	
23-Jun	10	0		100	1.0	0																	
24-Jun	11	0		100	1.0	0																	
24-Jun	14	30		100	1.0	0																	
24-Jun	16	34	777	100	1.0	0																	
24-Jun	16	50	155	500	7.2	205	235		.027	.551	.391	.067	.087	.028	377		.071	1.450	1.029	.176	.303	.074	.45
24-Jun	17	35	156	500	7.2	205	235		.020	.362	.333	.055	.072	.023	259		.053	.953	.876	.145	.250	.061	.25
25-Jun	9	15	157	500	5.9	233	260		.011	.135	.209	.030	.037	.012	164		.027	.336	.520	.075	.122	.029	.25
25-Jun	10	30	157	500	5.9	233	260		.011	.135	.209	.030	.037	.012	164		.027	.336	.520	.075	.122	.029	.25
27-Jun	11	30	159	500	4.3	315	340		.006	.051	.118	.023	.020	.007	78		.014	.119	.275	.054	.063	.016	.07
27-Jun	11	45	159	500	4.3	315	340		.006	.051	.118	.023	.020	.007	78		.014	.119	.275	.054	.063	.016	.07
27-Jun	16	0	161	1000	4.2	315	340		.012	.101	.244	.048	.040	.016	157		.014	.117	.284	.056	.065	.019	.13
28-Jun	10	55	162	1000	3.8	318	340		.010	.087	.205	.042	.036	.014	127		.011	.099	.235	.048	.057	.016	.05
29-Jun	10	0	163	1000	3.5	320	340		.009	.081	.188	.039	.033	.014	139		.010	.092	.213	.044	.053	.016	.07
30-Jun	9	15	164	1000	3.0	323	340		.008	.074	.173	.035	.030	.012	130		.009	.082	.192	.039	.047	.013	.07
06-Jul	11	0	171	1000	2.0	357	370		.010	.068	.145	.024	.025	.010	54		.010	.068	.145	.024	.025	.010	.02
13-Jul	11	0	172	1000	2.0	343	355		.009	.069	.147	.030	.031	.013	52		.009	.069	.147	.030	.031	.013	.02
20-Jul	10	40	999	1000	2.3	341	355																

33

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

SAMPLE TIME			HORIZONTAL EXTRACTION WELL - HEW-1										HEW-1		HEW-1						
			<< OPERATION DATA >>					<< GAS CHROMATOGRAPH READOUT >>							<< WELLHEAD CONCENTRATION >>						
				INJ	WELL	FLOW	FLOW	1,1	1,1,1				M,P-	TOTAL	1,1	1,1,1				M,P-	
			SAMP	VOL	VAC	RATE	RATE	DCE	TCA	TCE	TOL	PCE	XYL	AREA	DCE	TCA	TCE	TOL	PCE	XYL	OTHER
DATE	HRS	MIN	NUM	(ul)	("Hg)	(SCFM)	(ACFM)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	1000X	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)
14-Jun	12	17																			
14-Jun	12	18		100	1.0																
14-Jun	12	38		100	1.0																
14-Jun	13	18		100	1.0																
14-Jun	13	31		100	1.0																
14-Jun	14	31		100	1.0																
14-Jun	15	31		100	1.0																
14-Jun	15	40		100	1.0																
14-Jun	16	29		100	1.0																
14-Jun	17	29		100	1.0																
14-Jun	20	42		100	1.0																
15-Jun	8	39		100	1.0																
15-Jun	9	20		100	1.0																
15-Jun	11	30		100	1.0																
15-Jun	12	10		100	1.0																
15-Jun	12	23	777	100	1.0																
15-Jun	12	27	114	100	8.5	2	2	.377	1.360	.701	.034	1.015	.008	1210	5.26	15.26	9.76	.47	14.16	.11	9.70
15-Jun	14	50	115	100	9.5	17	20	.040	.241	.107	.030	.170	.015	154	.59	3.53	1.57	.44	2.49	.22	1.15
15-Jun	15	55	666	100	9.5	17	20														
15-Jun	16	2	888	100	9.5	25	30														
16-Jun	10	44	666	100	9.5	33	40														
16-Jun	13	6	122	100	8.8	34	40	.012	.065	.027	.006	.049	.003	44	.17	.92	.38	.08	.69	.04	.20
16-Jun	15	45	888	100	8.8	34	40														
16-Jun	16	30	999	100	1.0	39	40														
16-Jun	19	15	777	100	1.0	52	53														
17-Jun	10	45	124	100	8.4	66	80	.009	.054	.022	.003	.036	.001	54	.13	.75	.31	.04	.50	.01	.49
17-Jun	11	8	999	100	1.0																
17-Jun	11	40	777	100	1.0																
17-Jun	15	8	127	500	9.7	82	100	.031	.227	.050	.018	.163	.007	158	.09	.67	.27	.05	.46	.02	.20

TERRA VAC/ ECC - ERM SITE / PROJECT 88-304

SAMPLE TIME			HORIZONTAL EXTRACTION WELL - HEW-1 << OPERATION DATA >>					<< GAS CHROMATOGRAPH READOUT >> HEW-1							<< WELLHEAD CONCENTRATION >> HEW-1						
				INJ	WELL	FLOW	FLOW	1,1	1,1,1				M,P-	TOTAL	1,1	1,1,1				M,P-	
			SAMP	VOL	VAC	RATE	RATE	DCE	TCA	TCE	TOL	PCE	XYL	AREA	DCE	TCA	TCE	TOL	PCE	XYL	OTHER
DATE	HRS	MIN	NUM	(ul)	("Hg)	(SCFM)	(ACFM)	(ng/l)	(ng/l)	(ng/l)	(ng/l)	(ng/l)	(ng/l)	1000X	(ng/l)	(ng/l)	(ng/l)	(ng/l)	(ng/l)	(ng/l)	(ng/l)
18-Jun	18	0	131	500	7.2	90	103	.022	.152	.065	.013	.130	.005	102	.06	.51	.22	.03	.34	.01	.06
19-Jun	10	30	134	500	6.8	114	130	.014	.187	.090	.012	.147	.004	152	.04	.48	.23	.03	.38	.01	.22
19-Jun	10	47	999	100	1.0																
19-Jun	11	40		100	1.0																
20-Jun	9	20		100	1.0																
20-Jun	9	50		100	1.0																
20-Jun	10	35	777	100	1.0																
20-Jun	15	0	138	500	9.5	141	170	.013	.161	.074	.011	.133	.004	78	.04	.47	.22	.03	.39	.01	.04
21-Jun	9	0	139	1000	7.8	165	215	.020	.251	.138	.023	.255	.009	179	.03	.39	.19	.03	.34	.01	.08
21-Jun	9	33	999	100	1.0																
21-Jun	10	30		100	1.0																
22-Jun	10	0		100	1.0																
22-Jun	16	10		100	1.0																
23-Jun	10	0		100	1.0																
24-Jun	11	0		100	1.0																
24-Jun	14	30		100	1.0																
24-Jun	16	34		100	1.0																
24-Jun	16	50		100	1.0																
24-Jun	17	35		100	1.0																
25-Jun	9	15		100	1.0																
25-Jun	10	30		100	1.0																
27-Jun	11	30		100	1.0																
27-Jun	11	45		100	1.0																
27-Jun	16	0		100	1.0																
28-Jun	10	35		100	1.0																
29-Jun	10	0		100	1.0																
30-Jun	9	15		100	1.0																
06-Jul	11	0		100	1.0																
13-Jul	11	0		100	1.0																
20-Jul	10	40		100	1.0																

2-4

TERRA VAC/ ECC - EEN SITE / PROJECT 88 - 304

SAMPLE TIME			VERTICAL EXTRACTION WELL - VE-1													VERTICAL EXTRACTION WELL - VE-1						
			<< OPERATION DATA >>					<< GAS CHROMATOGRAPH READOUT >>								<< WELLHEAD CONCENTRATION >>						
DATE	HRS	MIN	SAMP NUM	INJ VOL (ul)	WELL VAC ("Hg)	FLOW RATE (SCFM)	FLOW RATE (ACFM)	1,1 DCE (ug/l)	1,1,1 TCA (ug/l)	TCE (ug/l)	TOL (ug/l)	PCE (ug/l)	M,P-XYL (ug/l)	TOTAL AREA 1000X	1,1 DCE (ug/l)	1,1,1 TCA (ug/l)	TCE (ug/l)	TOL (ug/l)	PCE (ug/l)	M,P-XYL (ug/l)	OTHER (ug/l)
14-Jun	12	17												0							
14-Jun	12	18		100	1.0									0							
14-Jun	12	38		100	1.0									0							
14-Jun	13	16		100	1.0									0							
14-Jun	13	31		100	1.0									0							
14-Jun	14	31		100	1.0									0							
14-Jun	15	31		100	1.0									0							
14-Jun	15	40		100	1.0									0							
14-Jun	16	29		100	1.0									0							
14-Jun	17	29		100	1.0									0							
14-Jun	20	42		100	1.0									0							
15-Jun	8	39		100	1.0									0							
15-Jun	9	20		100	1.0									0							
15-Jun	11	30		100	1.0									0							
15-Jun	12	10	777	100	8.8									0							
15-Jun	12	23	113	100	9.0	4	5	.606	1.501	2.584	.059	.267	.007	1049	8.657	21.44	36.91	.843	3.814	.100	1.89
15-Jun	12	27	888	100	8.8	4	5														
15-Jun	14	50	116	100	9.0	4	5	.078	.762	.558	.072	.082	.020	490	1.114	11.17	7.97	1.029	1.171	.286	2.62
15-Jun	15	55	666	100	9.0	8	10														
15-Jun	16	2	666	100	9.0	6	10														
16-Jun	10	46	888	100	8.5	13	15														
16-Jun	13	6	121	100	8.0	13	15	.008	.065	.030	.016	.008	.003	61	.109	.69	.41	.216	.109	.041	.40
16-Jun	15	45	888	100	1.0	15	15														
16-Jun	16	30	999	100	1.0	15	15														
16-Jun	19	15	777	100	1.0	15	15														
17-Jun	10	45	126	100	6.6	17	20	.016	.081	.062	.012	.015	.003	68	.226	1.15	1.16	.170	.212	.042	.36
17-Jun	11	0	999	100	1.0																
17-Jun	11	40	777	100	1.0																
17-Jun	15	8	128	500	10.0	4	5	.053	.339	.213	.070	.041	.017	280	.159	1.02	.64	.210	.123	.051	.33

B6

TERRA VAC/ ECC - ERM SITE / PROJECT 88 - 304

SAMPLE TIME			VERTICAL EXTRACTION WELL - VE-1 << OPERATION DATA >>					<< GAS CHROMATOGRAPH READOUT >>							VERTICAL EXTRACTION WELL - VE-1 << WELLHEAD CONCENTRATION >>						
DATE	HRS	MIN	SAMP NUM	INJ VOL (ul)	WELL VAC ("Hg)	FLOW RATE (SCFM)	FLOW RATE (ACFM)	1,1 DCE (mg/l)	1,1,1 TCA (mg/l)	TCE (mg/l)	TOL (mg/l)	PCE (mg/l)	M,P-XYL (mg/l)	TOTAL AREA 1000X	1,1 DCE (mg/l)	1,1,1 TCA (mg/l)	TCE (mg/l)	TOL (mg/l)	PCE (mg/l)	M,P-XYL (mg/l)	OTHER (mg/l)
18-Jun	10	0	132	500	7.8	4	5	.049	.339	.215	.061	.044	.016	256	.132	.92	.58	.165	.119	.043	.25
19-Jun	10	30	135	500	7.1	4	5	.038	.424	.256	.055	.048	.017	256	.100	1.11	.67	.144	.126	.045	.36
19-Jun	10	47	999	100	1.0																
19-Jun	11	40		100	1.0																
20-Jun	9	20		100	1.0																
20-Jun	9	50		100	1.0																
20-Jun	10	35		100	1.0																
20-Jun	15	0		100	1.0																
21-Jun	9	0		100	1.0																
21-Jun	9	33		100	1.0																
21-Jun	10	30	777	100	1.0																
22-Jun	10	0	140	500	14.6	4	5	.094	.568	.692	.047	.101	.017	364	.366	2.29	2.70	.183	.394	.066	.36
22-Jun	16	10	145	500	14.4	4	5	.081	.663	.690	.057	.124	.022	415	.312	2.55	2.65	.219	.477	.085	.48
23-Jun	10	0	146	500	14.5	4	5	.095	.899	.856	.071	.136	.032	556	.368	3.48	3.31	.275	.526	.124	.60
24-Jun	11	0	154	500	14.5	4	5	.019	.202	.211	.017	.033	.009	135	.074	.78	.82	.066	.128	.035	.20
24-Jun	14	30	999	500		5	5														
24-Jun	16	34	777	500	10.0	4	5														
24-Jun	16	50	888	500	6.7	4	5														
24-Jun	17	35	888	500	8.9	4	5														
25-Jun	9	15	999	500	8.0	4	5														
25-Jun	10	30	777	500	8.0	4	5														
27-Jun	11	30	160	500	6.8	4	5	.026	.437	.250	.069	.041	.036	277	.067	1.13	.75	.178	.106	.093	.22
27-Jun	11	45	999	500	6.8	4	5														
27-Jun	16	0		500	6.8	4	5														
28-Jun	10	35		500	6.8	4	5														
29-Jun	10	0		500	6.8	4	5														
30-Jun	9	15		500	6.8	4	5														
06-Jul	11	0		500	6.8	4	5														
13-Jul	11	0		500	6.8	4	5														
20-Jul	10	40		500	6.8	4	5														

ATTACHMENT 1

TERRA VAC CORPORATION

Project 88-304

Gas Chromatograph Parameters

I. SCOPE

In order to accurately quantitate Volatile Organic Compound (VOC) content it is necessary to insure peak separation. This is achieved by the use of an appropriate column, with the aid of a temperature program. The parameters for this program are set forth here.

II. EQUIPMENT AND REAGENTS

1. Clean and well lighted work area
2. Temperature progammable gas chromatograph (Shimadzu GC-9A) equipped with a flame ionization detector (FID) and a wide bore capillary column.
3. Nitrogen, carrier gas, zero grade or better
4. Hydrogen, combustion gas, zero grade or better
5. Air, combustion gas, zero grade or better

III. PARAMETERS

1. Initial temperature, 40 C
2. Initial hold, 2 minutes
3. Program rate, 5 C/minute
4. Intermediate temperature, 85 C
5. Intermediate hold, 0.5 minutes
6. Secondary ramp rate,15 C/minute
7. Final temperature,150 C
8. Final hold,3minutes
9. Inlet temperature, 150 C
10. Carrier gas flow, 20 ml/minute
11. Combustion gas flow, Air, 350 ml/minute
12. Combustion gas flow, Hydrogen, 55 ml/minute
13. Detector range, 10*1

IV. PRECAUTIONS

Do not exceed temperature limit of column. Do not operate oven without oven fan operating. Periodically check and clean air filter to electronics. Technician must be fully trained before attempting to operate the gas chromatograph.

ATTACHMENT 2

TERRA VAC CORPORATION

Project 88-304

Integrator Parameters

I. SCOPE

The parameters stated here are normal operating parameters for use with a flame ionization detector (FID). These parameters will require periodic optimization by the operator in order to achieve maximum sensitivity.

II. EQUIPMENT AND REAGENTS

1. Clean and well lighted work area
2. Integrator (Shimadzu C-R3A)

III. PARAMETERS

1. Zero = 0
2. Attenuation (ATTN 2) = 4
3. Chart speed (CHT SP) = 10 mm/min.
4. Area reject (AR REJ) = 250
5. Slope = 300

IV. PRECAUTIONS

It is important that the operator has a full understanding of the instrument in order to achieve optimization. If in doubt about any procedure, refer to the operation manual.

ATTACHMENT 3

TERRA VAC CORPORATION

Project 88-304

Sampling Techniques of Volatile Organic Compounds

I. SCOPE

Volatile Organic Compounds (VOC) are regulated, toxic chemicals and should be treated with care to avoid personal and environmental contamination.

When sampling vapors from the vacuum system it will be considered that the air stream is contaminated with VOC's.

II. EQUIPMENT AND REAGENTS

1. Clean and well lighted work area
2. Hamilton Gastight Syringes 1000ul, 500ul, 250ul sizes

III. PROCEDURE

1. Purge syringe with clean air
2. Insert syringe into well head septum
3. Purge syringe with air stream to be sampled
4. Draw plunger back to desired volume
5. Withdraw needle from wellhead septum and stopper with a septum

6 Log time, location, wellhead vacuum and flow then return sample to GC

IV. PRECAUTIONS

Test syringe before use for leaking plunger and tight needle.

ATTACHMENT 4

TERRA VAC CORPORATION

Project 88-304

Volatile Organic Compounds Standard

I. SCOPE

The purpose of this procedure is to define the standardization of the gas chromatograph for reference in the quantitative analysis of samples containing unknown amounts of Volatile Organic Compounds.

II. EQUIPMENT AND REAGENTS

1. Clean and well lighted work area
2. Gastight syringes 1000ul,250ul,100ul.
3. Pure compounds (CAUTION: Some VOC's are known carcinogens and should be handled with care to avoid possible contamination.)
4. Gas sampling bulb 1000ml size

III. PROCEDURES

Calibration using pure VOC to make gas standard

1. Run a blank of the syringe and 1 liter gas sampling bulb to be used.
2. Inject a known volume of the liquid VOC (or of an equal volume mixture of several compounds of interest) into the 1 liter bulb (verify actual bulb volume beforehand). This is on the order of 1 ul for 100 to 300 ppm levels.
3. Allow the liquid to vaporize and disperse throughout the bulb. This may take 5-10 minutes depending on volatility of the compounds. See precautions.
4. Using a gastight syringe, withdraw a 100-1000ul sample from the bulb and inject it into the GC. Volume utilized should approximate expected field concentrations.
5. Calculation of concentration:

$$mg/L = \frac{sp.gravity*liq.vol*\%purity*inj.volume(ul)}{bulb\ volume * 100\% *1000ul}$$

6. If not within 10% of previous calibration,repeat 4&5. Otherwise maintain calibration values established.

7. Calibrate to new values when repeatability is shown. See precautions.

IV PRECAUTIONS

1. In injecting headspace vapor from pure compound, care must be taken not to overload the column.

2. A wide change in calibration values indicates that troubleshooting of the system or procedures is necessary.

3. In using a liquid, be sure the volume injected will be well below vapor saturation for the bulb volume used.

4. Examine the bulb for any droplets or condensation that may indicate incomplete vaporization of the liquid. Some warming of the bulb (i.e.,sunlight, rubbing with a cloth, even the GC oven briefly) may hasten the process. The less volatile the compound, the more problem this becomes.

5. Do not rely on the bulb's integrity for more than an hour.

APPENDIX B

ECC REMEDIAL ACTION PLAN
ESTIMATION OF WATER VOLUMES COLLECTED
IN THE GROUND WATER INTERCEPTION TRENCH

APPENDIX B

ECC REMEDIAL ACTION PLAN
ESTIMATION OF WATER VOLUMES COLLECTED IN THE GROUND WATER INTERCEPTION TRENCH

Following the procedure in Appendix B of the FS:

$$Q_t = Q_r + Q_i + Q_{rec}$$

where:

Q_t = total water flow to the trench, gpm

Q_r = regional ground water flow to the trench, gpm

Q_i = flow induced due to the presence of the trench, gpm

Q_{rec} = recharge flow, due to precipitation and upward recharge from the sand and gravel unit, gpm

$$Q_r = K_r \cdot A_r \cdot i_r$$

where:

K_r = permeability of till = 10^{-5} cm/s = 0.212 gal/d.ft^2 (section 5 of RI)

d = depth of trench, assume 10 ft

A_r = area of trench in the direction of ground water flow, ft^2 = L x d

L = length of trench, 330 ft

i_r = regional gradient = 0.05 ft/ft south of the site (Appendix B of FS)

$$Q_i = K_i \cdot i_I \cdot A_i$$

where:

K_i = permeability of till = 10^{-5} cm/s - 0.212 gal/d.ft^2 (Section 5 of RI)

i_i = gradient induced due to drain - h/l

h = height of water table above the drain centers = 1/2 maximum depth = 5 ft

l = z/2 = 20 ft

z = zone of influence of trench in the perpendicular direction, 40 ft

A_i = area of induced flow = L x h

$$Q_{rec} = (W_p + W_v)\ A_{rec}$$

where:

W_p = recharge due to precipitation, assumed to be 7.8 in/yr = 0.013 gal/d.ft^2 (Appendix B of FS)

W_v = recharge due to upward movement from the sand and gravel unit = k_v x i_v

k_v = vertical permeability of till assumed to be 10^{-5} cm/s = 0.212 gal/d.ft^2

i_v = vertical gradient = 0.25 ft/ft = 3 ft difference in head over 12 ft of thickness of shallow saturated zone (Appendix B of FS)

A_{rec} = recharge area, ft^2 - L x Z

For the trench to be installed at ECC =

Q_r = 0.212 gal/d.ft2 x 330 ft x 10 ft x 0.05 ft/ft x 1 d/1440 min
= 0.03 gpm

Q_i = 0.212 gal/d.ft^2 x 330 ft x 5 ft x 0.25 ft/ft x 1 d/1440 min
= 0.06 gpm

Q_{rec} = 0.013 gal/d.ft^2 x 330 ft x 40 ft x 1 d/1440 min + 0.212 gal/d.ft^2 x 330 ft x 40 ft x 0.25 ft/ft x 1 d/1440 min
= 0.61 gpm

Q_t = 0.03 + 0.06 + 0.61 = 0.70 gpm